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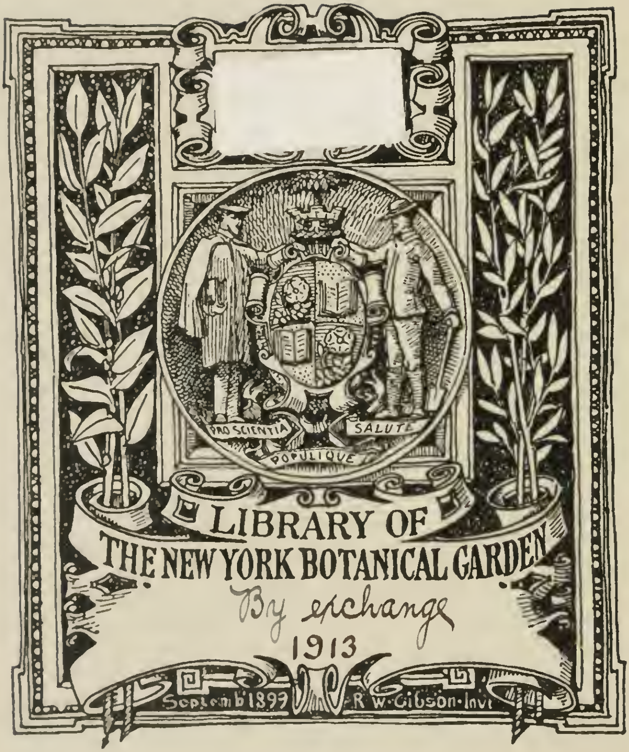
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VOLUME II Nos. 1 and 2

THE MONTHLY BULLETIN

INJURIOUS AND BENEFICIAL INSECTS
OF
CALIFORNIA

By E. O. ESSIG

OF

STATE COMMISSION OF HORTICULTURE

SACRAMENTO, CALIFORNIA JANUARY AND FEBRUARY, 1913

STATE COMMISSION OF HORTICULTURE
January and February, 1913

THE MONTHLY BULLETIN

VOLUME II Nos. 1 and 2

DEVOTED TO THE DESCRIPTIONS, LIFE HABITS AND METHODS OF CONTROL OF INSECTS FUNGOID DISEASES AND NOXIOUS WEEDS AND ANIMALS, ESPECIALLY IN THEIR RELATIONS TO AGRICULTURE AND HORTICULTURE.

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E. O. ESSIG

Secretary State Commission of Horticulture

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INTRODUCTION AND ACKNOWLEDGMENT.

There have always been repeated requests at this office for publications on California insects, suitable for use by the orchardist and horticultural inspector. To meet these demands Mr. O. E. Bremner, then secretary of the State Commission of Horticulture, issued a bulletin on "Destructive Insects and Their Control" in the year 1910. That the work was popular is shown by the fact that the large supply printed has been entirely exhausted for nearly a year and with urgent requests continuing to arrive at the office for a similar treatise. The present bulletin has been printed to meet these demands.

It has been the aim to make this issue as clear, concise and practical as possible. Only insects of the most economic importance known to occur in California are considered, so this is in no wise a work on general entomology, and such limitations will better enable an orchardist or horticultural official to get a more thorough grasp of the field of insect life as it actually exists in this State.

Much of the information contained herein has been compiled from entomological publications of the State University, the many state experiment stations, Bureau of Entomology of the United States Department of Agriculture, and of private authors.

The cuts already in the office have been used for illustrative purposes as far as available. Most of these are reproductions from publications of the United States Department of Agriculture. The State University has also loaned us a generous supply. The author's illustrations formerly used in the Pomona College Journal of Entomology have also been procured, while many new cuts appear herein for the first time.

E. O. ESSIG.

Sacramento, California.
January 1, 1913.

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- Squash bug, *Anasa tristis* 147
- Striped cucumber beetle, *Diabrotica vittata* 230
- Twelve-spotted cucumber beetle, *Diabrotica soror* 229

Stangeria schizodon.
- Long-tailed mealy bug, *Pseudococcus longispinus* 106

Strawberry (*Fragaria* sp.).
- False chinch bug, *Nysius angustatus* 149
- Fuller's rose beetle, *Aramigus fulleri* 240
- Grain thrips, *Euthrips tritici* 33
- Greenhouse orthezia, *Orthezia insignis* 93
- Strawberry crown borer, *Sesia rutilans* 191

Strobilanthes sp.
- Greenhouse orthezia, *Orthezia insignis* 93

Sunflower (*Helianthus annuus*).
- Bean thrips, *Heliothrips fasciatus* 30
- Beet army worm, *Laphygma exigua* 163
- Harlequin cabbage bug, *Murgantia histrionica* 146

Sumach (*Rhus* sp.).
- Apple leaf-hopper, *Empoasca mali* 41
- Black scale, *Saissetia oleæ* 119
- Cantaloupe fly, *Euxesta notata* 249
- Cottony maple scale, *Pulvinaria vitis* 111
- Ivy scale, *Aspidiotus hederæ* 129

Sweet Alyssum (*Alyssum maritimum*).
- Cabbage worm, *Pontia rapæ* 197

Sweet Gum (*Liquidambar styraciflua*).
- Cottony cushion scale, *Icerya purchasi* 89

Sycamore (*Platanus* sp.).
- Black scale, *Saissetia oleæ* 119
- Cottony maple scale, *Pulvinaria vitis* 111
- Frosted scale, *Eulecanium pruinosum* 116

Tacsonia mollissima.
- Bean thrips, *Heliothrips fasciatus* 30

Tallow Tree (*Sapium sebiferum*).
- Oyster shell scale, *Lepidosaphes ulmi* 139

Tangerine, see Citrus.

Tea (*Thea* sp.).
- Florida wax scale, *Ceroplastes floridensis* 113
- Greenhouse orthezia, *Orthezia insignis* 93
- Japanese wax scale, *Ceroplastes ceriferus* 111
- Red scale, *Chrysomphalus aurantii* 133

Thespesia sp.
- Black scale, *Saissetia oleæ* 119

Tobacco (*Nicotiana tabacum*).
- Citrus mealy bug, *Pseudococcus citri* 102
- Potata tuber moth, *Phthorimæa operculella* 167
- Tobacco sphinx, *Phlegethontius quinquemaculata* 157
- Tomato sphinx, *Phlegethontius sexta* 156

Tobacco, Tree (*Nicotiana glauca*).
- Bean thrips, *Heliothrips fasciatus* 30

Tobacco, Wild (*Mimulus bolanderi*).
- Beet army worm, *Laphygma exigua* 163

Thorn-apple (*Datura* sp.).
- Apple-leaf-hopper, *Empoasca mali* 41

Thunbergia sp.
- Greenhouse orthezia, *Orhtezia insignis* 92, 93
- Six-spotted mite, *Tetranychus bimaculatus* 8

Tick, Bean, see Broad Bean.

Tomato (*Lycopersicum esculentum*).
- Greenhouse orthezia, *Orthezia insignis* 93
- Greenhouse white fly, *Aleyrodes vaporariorum* 145

Tomato—Continued. PAGE.
- Green peach aphid, *Myzus persicæ* 79
- Six-spotted mite, *Tetranychus bimaculatus* 8
- Tobacco sphinx, *Phlegethontius quinquemaculata* 157
- Tomato sphinx, *Phlegethontius sexta* 156
- Tomato worm, *Heliothis obsoleta* 165
- Western army worm, *Chorizagrotis agrestis* 163
- White-lined sphinx, *Celerio lineata* 156

Tree of Heaven (*Ailanthus glandulosa*).
- Citrus white fly, *Aleyrodes citri* 144, 350

Trumpet Vine (*Tecoma radicans*).
- Citrus white fly, *Aleyrodes citri* 350

Tulip (*Tulipa* sp.).
- Bean thrips, *Heliothrips fasciatus* 30

Turnip (*Brassica rapa*).
- Bean thrips, *Heliothrips fasciatus* 30
- Cabbage maggot, *Phorbia brassicæ* 256, 257
- Cabbage worm, *Pontia rapæ* 196
- False chinch bug, *Nysius angustatus* 150
- Harlequin cabbage bug, *Murganita histrionica* 146
- Hop flea beetle, *Psylliodes punctulata* 231
- Western army worm, *Chorizagrotis agrestis* 163

Tylophora asthmatica.
- White peach scale, *Aulacaspis pentagona* 125

Umbrella Plant (*Cyperus alternifolius*).
- Citrus mealy bug, *Pseudococcus citri* 102
- Ivy scale, *Aspidiotus hederæ* 128
- Long-tailed mealy bug, *Pseudococcus longispinus* 106

Umbrella tree (*Melia azedarach*).
- Citrus thrips, *Euthrips citri* 34
- Citrus white fly, *Aleyrodes citri* 144, 350
- Greedy scale, *Aspidiotus camelliæ* 127
- Ivy scale, *Aspidiotus hederæ* 128

Verbena sp.
- Cottony cushion scale, *Icerya purchasi* 89
- Greenhouse orthezia, *Orthezia insignis* 92
- Greenhouse thrips, *Heliothrips hæmorrhoidalis* 32
- Six-spotted mite, *Tetranychus bimaculatus* 8

Veronica sp.
- Cottony cushion scale, *Icerya purchasi* 89
- Greenhouse orthezia, *Orthezia insignis* 93

Vetch (*Vicia sativa*).
- Destructive pea louse, *Macrosiphum destructor* 74

Violet (*Viola* sp.).
- Six-spotted mite, *Tetranychus bimaculatus* 8
- Violet louse, *Rhopalosiphum violæ* 76

Vitex littoralis.
- Ivy scale, *Aspidiotus hederæ* 128

Vriesia splendens.
- Ivy scale, *Aspidiotus hederæ* 128

Wall Flower (*Erysimum vulgare*).
- Parsnip louse, *Hyadaphis pastinacæ* 86

Walnut, Black (*Juglans californica*).
- Apple leaf-hopper, *Empoasca mali* 41
- Orange tortrix, *Tortrix citrana* 176
- Scurfy scale, *Chionaspis furfura* 123
- Wild walnut louse, *Monellia californica* 83

Walnut, English (*Juglans regia*).
- Broad-necked borer, *Prionus laticollis* 234
- California tussock moth, *Hemerocampa vetusta* 179
- Cottony cushion scale, *Icerya purchasi* 89
- Frosted scale, *Eulecanium pruinosum* 116
- Greedy scale, *Aspidiotus camellia* 127
- Pear thrips, *Euthrips pyri* 36
- Red scale, *Chrysomphalus aurantii* 133

Walnut, English—Continued. PAGE.
San Jose scale, *Aspidiotus perniciosus* 130
Walnut mealy bug, *Pseudococcus bakeri* 99
Walnut plant louse, *Chromaphis juglandicola* 81
Walnut scale, *Aspidiotus juglans-regiæ* 129
White peach scale, *Aulacaspis pentagona* 124
Wandering Jew (*Tradescantia* sp.).
Citrus mealy bug, *Pseudococcus citri* 102
Watermelon (*Citrullus vulgaris*), see Melon.
Black scale, *Saissetia oleæ* 119
Striped cucumber beetle, *Diabrotica vittata* 230
Wattle (*Acacia melanoxylon*), see Acacia.
Red scale, *Chrysomphalus aurantii* 133
Wheat (*Triticum* sp.).
Angoumois grain moth, *Sitotroga cerealella* 173
Grasshoppers 16
Hessian fly, *Mayetiola destructor* 245
White Beam Tree, see Sorbus.
Wild Pea (*Lotus americanus*).
Bean thrips, *Heliothrips fasciatus* 30
Willow (*Salix* sps.).
Citrus thrips, *Euthrips citri* 34
Cottony cushion scale, *Icerya purchasi* 89
Cottony maple scale, *Pulvinaria vitis* 111
Greedy scale, *Aspidiotus camelliæ* 127
Orange tortrix, *Tortrix citrana* 176
Oyster shell scale, *Lepidosaphes ulmi* 139
Parsnip louse, *Hyadaphis pastinacæ* 86
Red scale, *Chrysomphalus aurantii* 133
San Jose scale, *Aspidiotus perniciosus* 130
Spotless fall webworm, *Hyphantria textor* 190
White peach sale, *Aulacaspis pentagona* 125
Wire Grass (*Polygonum arviculare*).
Bean thrips, *Heliothrips fasciatus* 30
Yarrow (*Achillea millefolium*).
Beet louse, *Pemphigus betæ* 53
Yew (*Taxus* sp.).
Purple scale, *Lepidosaphes beckii* 137
Yucca sps.
Diplacus ceroputo, *Ceroputo yuccæ* 96
Ivy scale, *Aspidiotus hederæ* 128
Zamia sp.
Hemispherical scale, *Saissetia hemisphærica* 117
Long-tailed mealy bug, *Pseudococcus longispinus* 106
White peach scale, *Aulacaspis pentagona* 125
Zinnia sp.
Twelve-spotted cucumber beetle, *Diabrotica soror* 229

GENERAL CLASSIFICATION.

Insects belong to the phylum Arthropoda, a group of animals having jointed bodies and jointed legs. In the same phylum are to be found the following classes:

1. **Crustacea.**—Water-breathing animals, with many legs and hard exoskeleton; head and thorax united. Examples: crabs, lobsters, crayfish and sowbugs.

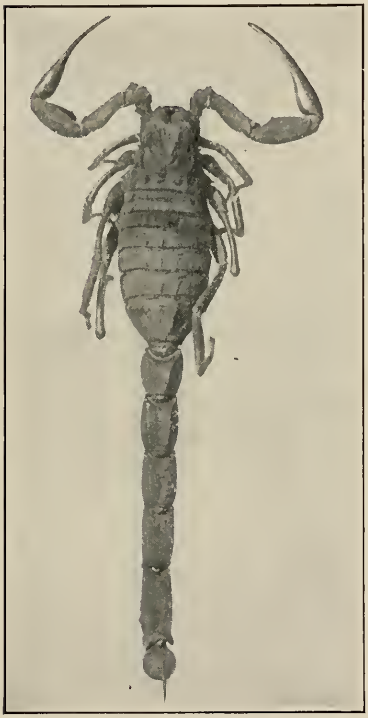

FIG. 1.—A scorpion, *Buthus* sp. (After Folsom.)

2. **Arachnida.**—Land forms; eight legs, head and thorax united. Examples: scorpions (Fig. 1), solpugids, spiders, mites (Fig. 2) and ticks.

3. **Malacopoda.**—Land forms; body worm-like with numerous legs. A very peculiar animal which is seldom met with. Example: *Peripatus*.

4. **Diplopoda.**—Land forms; body long, cylindrical, many segmented; two pairs of short legs to each segment; antennæ short. Example: thousand-legged worms (*Spirobolus*). (Fig. 3.)

5. **Chilopoda.**—Land forms; body long, flat, many segmented; one pair of rather long legs to each segment; antennæ long. Example: centipedes (*Scolopendra*). (Fig. 4.)

6. **Insecta or Hexapoda.**—Aquatic and terrestrial, but primarily the latter. Body of the adults divided into three distinct regions: head, thorax and abdomen. Adult forms with six legs and many are winged. Transformations or metamorphoses occur in all except the two lowest orders, *Thysanura* and *Collembola*. Example: insects.

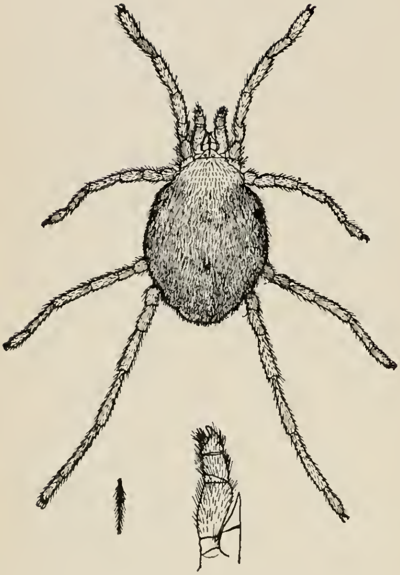

FIG. 2.—A mite, *Rhyncolophus arenicola* Hall. (After Hall.)

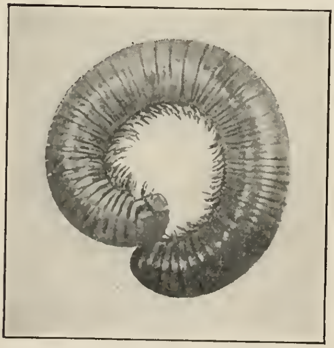

FIG. 3.—A diplopod, *Spirobolus marginatus*. (After Folsom.)

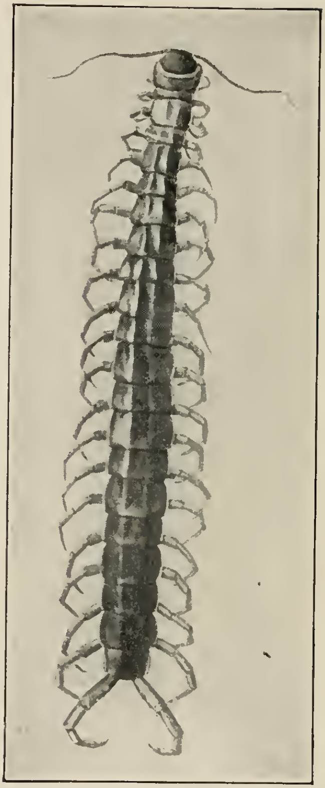

FIG. 4.—A centipede, *Scolopendra heros*. (After Folsom.)

ARACHNIDA (Class).

SPIDERS AND MITES.

Because of their economic importance we have thought it best to include here the common injurious mites of California, even though they are not insects. As pointed out in the general classification, mites usually have eight legs and have the head and thorax united. Some species, however, especially the blister mites, have only four legs, while the young red spiders have six legs before the first molt.

All forms feed by piercing the plant tissues and extracting the juice. They multiply very rapidly and thus are capable of much damage.

The winters are usually passed in the adult stage, under buds and bark scales. As soon as the first leaves appear the mites begin work. The eggs are laid singly on the outside or inside of the plant tissues, or in clusters upon the bark; in the latter case they may be deposited around the buds, some time before they begin to open. The young develop very rapidly and are soon capable of bringing forth new broods. The breeding continues throughout the summer—the greatest number of mites being evident during the hottest and dryest weather. Cold, damp weather seems to retard all activities.

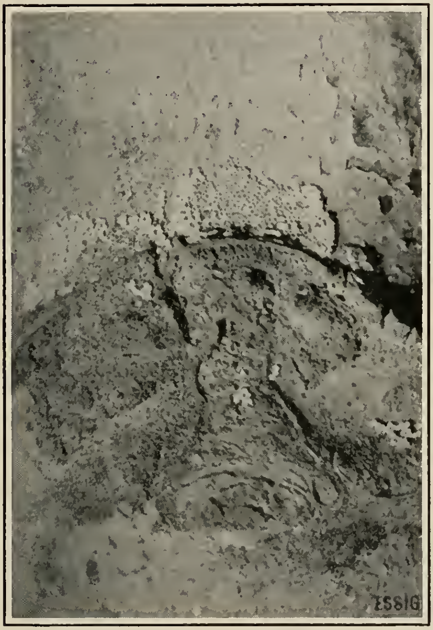

FIG. 5.—Mite eggs deposited around a bud. Greatly enlarged. (Original.)

Control.—The control of mites has been no little task and considerable work has been done with exceedingly satisfactory results. Mites are generally controlled either by the application of dry flowers of sulphur alone, finely powdered dehydrated lime and flowers of sulphur in equal proportions, by hand or with a blower, or a two per cent solution of commercial lime-sulphur with spraying machines. A late development in the control of mites on truck crops has resulted in the discovery by the United States Department of Agriculture of a flour paste, made by mixing four pounds of flour in one hundred gallons of water and adding one gallon of lime-sulphur solution. This is applied as a spray.

Strong solutions of commercial lime-sulphur (1 to 11) as used for scale insects will greatly aid in ridding deciduous trees of the over-wintering mites.

Thorough application is essential to obtain good results. A fine mist under high pressure is especially desirable in applying the spray.

THE SILVER MITE OF THE LEMON.

Eriophyes oleivorus Ashm.

(*Phytoptus oleivorus* Ashm.)

(Fig. 6.)

General appearance.—The adult mites are so small as to be invisible except with the aid of a lens. They are light yellow in color, long and pointed anteriorly with two pairs of legs near the head. The eggs are exceedingly small, circular and faintly yellow in color. The presence of the mite is easily told by the characteristic silvery chafing of the skin of the lemon, due to the destruction of the oil cells. In Florida the oranges are also chafed, causing a russeting.

Life History.—The eggs are deposited singly or in small clusters on the leaves or fruit. They hatch in less than a week in hot weather but require twice as long in cold weather. After several molts the mites become full grown in from two to three weeks. The young and adults feed upon the oil in the succulent parts of citrus plants, which is obtained by piercing the oil cells with their beaks. The adults are capable of rapid locomotion and move freely. They breed from spring until late fall, giving rise to many overlapping broods a year.

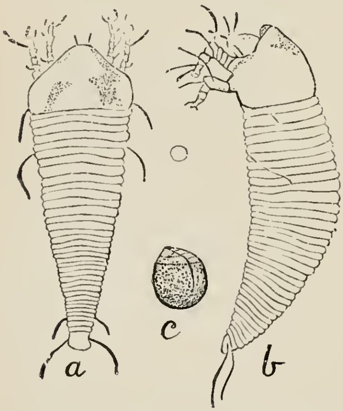

FIG. 6.—The silver mite (*Eriophyes oleivorus* Ashm.); *a* and *b*, dorsal and lateral views of adult; *c*, egg. (After Hubbard.)

Distribution.—Though this mite was introduced into San Diego County in 1889, it has spread very little, and is still confined to the extreme southern part of the State.

Food plants.—Works upon bark, foliage and fruits of citrus trees. In California its attacks are usually confined to the lemon.

Control.—Same as for the citrus red spider (*Tetranychus mytilaspidis*).

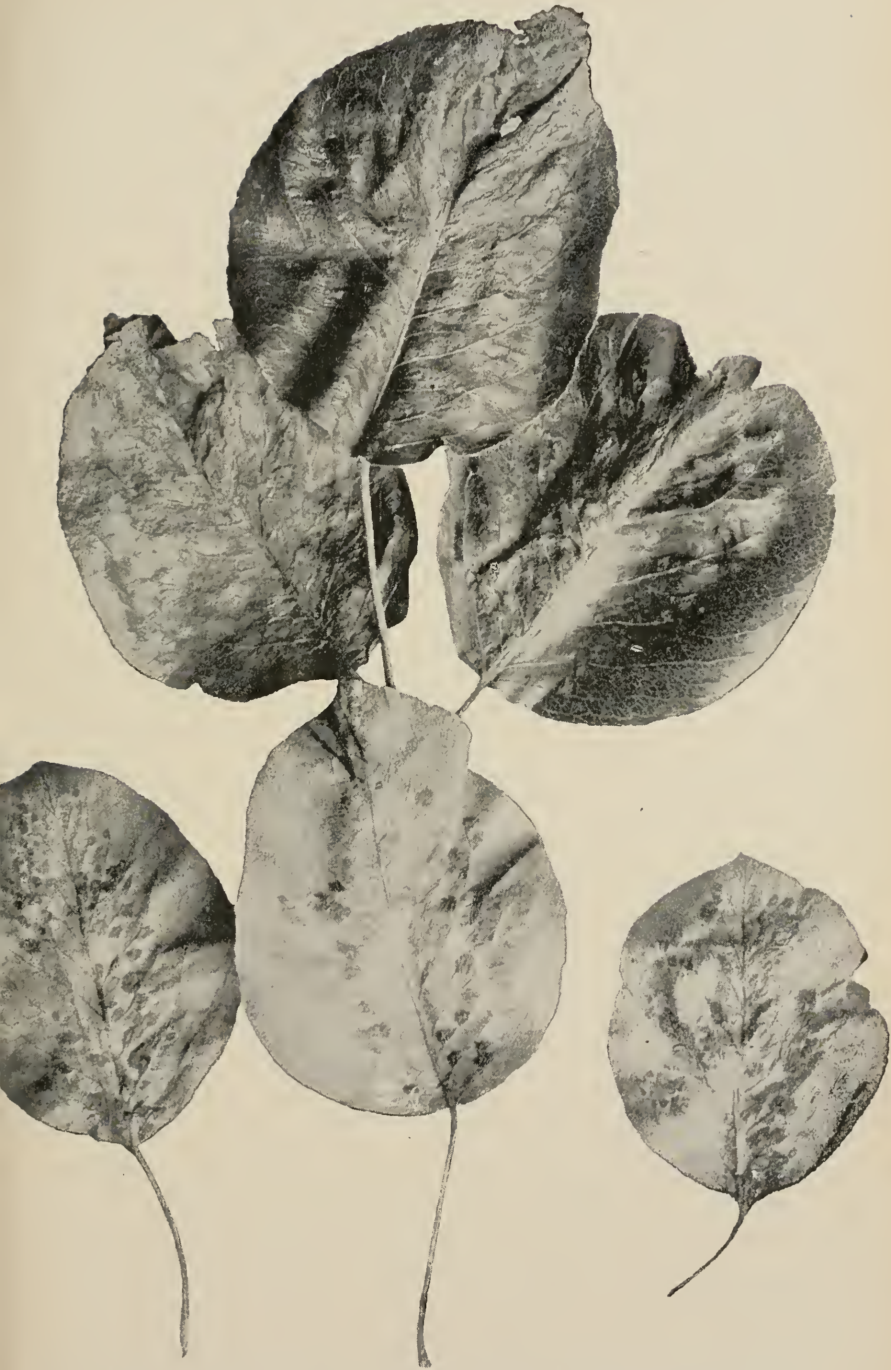

FIG. 7.—Work of the pear-leaf blister-mite (*Eriophyes pyri* Pgst.) on pear leaves. (Cal. Hort. Com.)

PEAR-LEAF BLISTER-MITE.

Eriophyes pyri Pgst.

(Figs. 7, 8.)

General Appearance.—The work of this mite makes its presence easily distinguishable from all others. Pear leaves are so affected as to produce reddish or dark brown spots which become darker with age and may spread so as to entirely cover and destroy the foliage. On the apple the galls remain the color of the leaves. The younger shoots suffer most. The mites are very minute and can be seen only with the aid of a microscope. The body is elongated with roughened surface, transparent and having but two pairs of legs near the head.

Life History.—The mites pass the winter on the trees under the bud scales and begin to work upon the leaves as soon as they appear in the spring. The eggs are deposited in holes bored into the undersides of the leaves. The work of the young after hatching causes the galls or swellings. The destructiveness continues throughout the summer and until the leaves begin to fall in winter. There are several generations each year.

Distribution.—Especially abundant in the San Joaquin and Sacramento valleys.

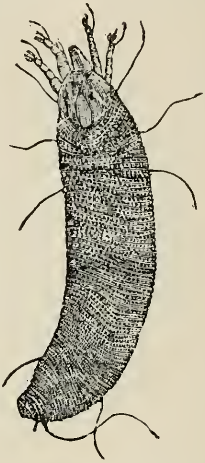

FIG. 8.—The pear-leaf blister-mite, *Eriophyes pyri* Pgst. (U. S. Dept. Agrcl)

Food Plants.—The pear and apple are seriously affected, the mites attacking the foliage as well as the stems of the leaves and fruit. On the foliage of the pear the galls are made along the sides of the midribs of the leaves; on the apple at the base and along the margins of the leaves. Other plants found as hosts are white beam tree, European mountain ash, wild service berry, common cotoneaster.

Control.—Same as for the common red or six-spotted spider or mite. (*Tetranychus bimaculatus* Harv.)

THE CLOVER OR ALMOND MITE.

Bryobia pratensis Garman.

(Fig. 9.)

General appearance.—The young mites are red, becoming brown when fully developed. Though very much smaller than a pinhead this species is much larger than any of the common destructive mites in this State. The eggs are very minute, so small as to be scarcely visible to the naked eye; globular and red.

Life History.—The eggs deposited in the fall hatch with the first warm spring weather and the mites at once begin to work. Their development is very rapid and reproduction exceedingly great, so by summer there are often sufficient numbers to do great damage. Breeding and work continue until fall, when the eggs are laid and operations suspended until these hatch in the spring.

Distribution.—Abundant in all parts of the State.

Food Plants.—This mite is an omnivorous feeder and may be found upon a great variety of plants. Peas, clover and alfalfa are severely attacked, while they also feed upon grass, grains and buckwheat. Peach, apple, plum, apricot, prune, cherry, almond and quince trees are also among the food plants.

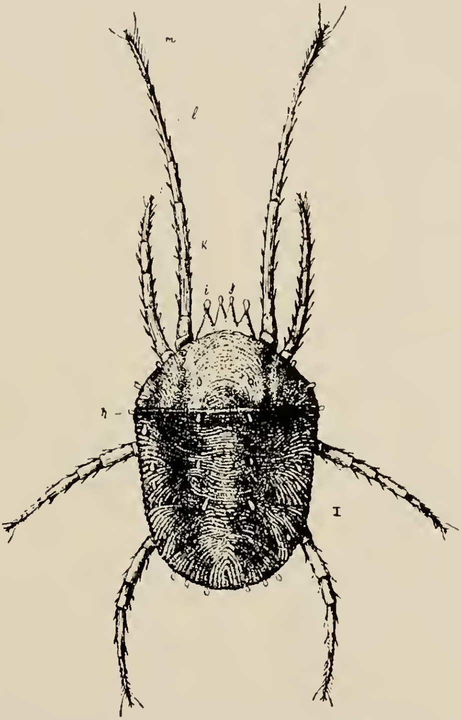

Fig. 9.—The clover or almond mite, *Bryobia pratensis* Gar. (After Riley and Marlatt.)

Control.—For this pest Mr. W. H. Volck especially recommends the following formula: water, 100 gallons; flour paste, 4 gallons; lime-sulphur solution, 5 quarts; iron sulphate, 2 pounds. The flour paste and lime sulphur are thoroughly mixed in the spray tank after which the iron sulphate is added and all thoroughly agitated.

Natural Enemies—The larvæ of the minute black ladybird beetles (*Stethorus vagans* Blackb. and *Stethorus picipes* Casey) and the green lacewing (*Chrysopa californica* Coq.) prey upon the clover mite but they do not appear to be important factors in keeping it down.

THE COMMON RED OR SIX-SPOTTED SPIDER OR MITE.

Tetranychus bimaculatus Harv.[*]

(*Tetranychus sexmaculatus* Riley.)

(Fig. 10.)

General Appearance.—This species (like the other mites) is exceedingly small and individuals are seldom noticed excepting when they collect in great numbers. The color is red with a yellowish tinge and usually with two darker spots on each side of the body. The young greatly resemble the adults but have six rather than eight legs.

Life History.—The mites usually begin to appear after the first warm weather in the spring, the winter having been spent in the ground. They spin threads so as to conceal themselves, their eggs and young, on the undersides of the leaves and feed directly upon the tissues of the plant by sucking which gradually stunts and kills the latter. The common red mite is a serious greenhouse pest, where, under favorable conditions, it is able to work throughout the entire year.

Distribution.—Though of foreign origin this mite has become thoroughly distributed over the entire State and is met alike in field and greenhouse.

Food Plants.—This mite is an omnivorous feeder, apparently without any favorite food. The plants which it is known to attack are sugar beets, beans, sage, tomato, eggplant, pepper, cucumber, squash, cowpea, hops, berries, violet, rose, clematis, mignonette, pink, fuchsia, pelargonium, godetia, passiflora, feverfew, thunbergia, verbena, heliotrope, moon-flower, calla, smilax and easter lily.

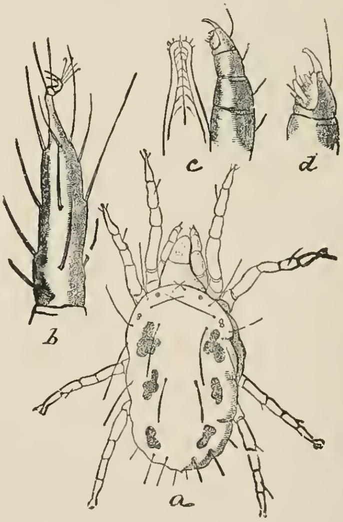

FIG. 10. The common red spider (*Tetranychus bimaculatus* Harv.). *a*, adult; *b*, tarsus; *c*, beak and palpus; *d*, tip of palpus. (U. S. Dept. Agrcl.)

Control.—Sulphur and dehydrated lime mixed in equal proportions and thoroughly sprinkled over the plants are recommended. Sprays such as emulsions, resin wash and soap solutions are efficient remedies, but these are usually too destructive to the tender leaves of the food plants to be practicable. The flour paste spray is especially recommended in such cases.

Natural Enemies.—The minute black ladybird beetles (*Stethorus vagans* and *Stethorus picipes*) and the larvæ of the syrphid flies prey upon this mite.

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[*] We are informed by Dr. H. E. Ewing that the correct name of this species is *Tetranychus telarius* Linn.

THE CITRUS RED SPIDER.

Tetranychus mytilaspidis Riley.

(Fig. 11.)

General Appearance.—The adult insects are cardinal red and scarcely larger than a pin point. They often occur so abundantly as to give the fruit and foliage a red color. The eggs are globular and red, as are also the younger stages.

Life History.—The eggs are suspended upon minute stalks with guy webs as supports. They hatch in from nine to twelve days, being laid from May on throughout the warm summer months. The first born are six-legged but after the first molt acquire another pair, making the usual number. In two weeks they are full grown and begin egg laying. They live from thirty to thirty-five days, thus making the life cycle cover a period of about six weeks. By far the greater numbers occur during the warm summer months when most of the damage is done, but great damage often occurs until late in winter. On deciduous fruit trees the eggs are deposited at the bases of the last year's shoots and do not hatch until the following spring.

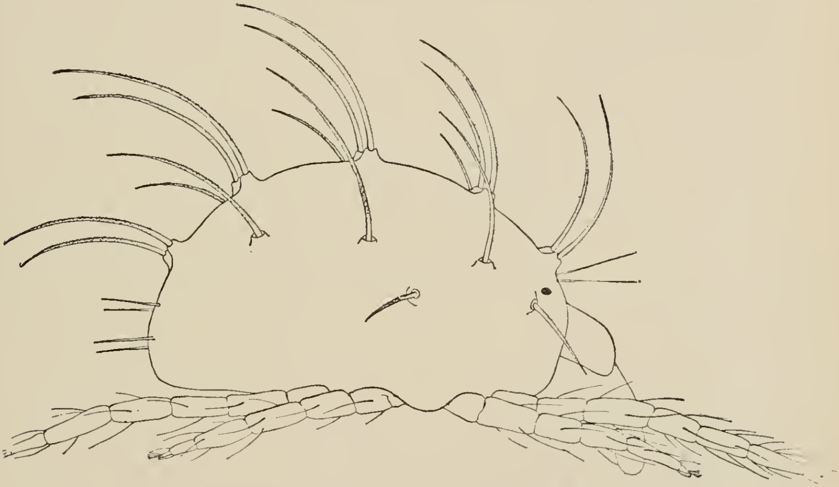

FIG. 11.—The citrus red spider, *Tetranychus mytilaspidis* Riley. Much enlarged. (After Volck. Courtesy Cal. Exp. Sta.)

Distribution.—Occurs throughout most of the State, but is particularly destructive in the southern citrus-growing sections.

Food Plants.—Primarily a citrus pest, working uniformly upon the foliage and fruit. Other food plants are as follows: apple, prune, peach.

Control.—The first methods of control consisted in the application of dry flowers of sulphur thrown upon the tree by hand. Later power blowers were employed and these are still used, but to the sulphur is added an equal amount of dehydrated lime. The applications are preferably made early in the morning when the foliage is damp and the dust readily adheres to it; however in large groves it is often impossible to delay for such favorable conditions. In cold weather the dry sprays do little or no good, due to the slow liberation of the fumes.

During the past few years liquid sprays of the commercial lime-sulphur have met with great favor and promise to completely do away with the dust sprays. The commercial product is reduced to from 2 to 2½ per cent and applied as a fine mist under a pressure of from 150 to 200 pounds. Care must be taken not to use the spray stronger than is absolutely necessary, for in some cases severe burnings occur to young lemons.

Applications of both the dry and liquid sprays should be made as soon as the spiders appear in any considerable number.

Natural Enemies.—Natural enemies play an important part in the control of the citrus red spider and are often responsible for keeping its numbers so small as to do little damage. *Conventzia hageni* Banks, the green lacewing (*Chrysopa californica* Coq.) and the brown lacewings (*Sympherobius angustus* Bks. and *Hemerobius pacificus* Bks.) are important enemies belonging to the order *Neuroptera*. The minute black ladybird beetles (*Stethorus vagans* and *S. picipes*), a staphylinid beetle (*Oligota oviformis* Casey), the thrips (*Scolothrips sexmaculatus* Perg.), the larvæ of a fly (*Arthroconodax occidentalis* Felt) and the carnivorous bug (*Thriphleps insidiosus* Say) prey upon the red spiders.

INSECTA OR HEXAPODA (Class).

INSECTS.

*ORDERS.

The following study is based upon the order as a unit of classification. This is done to avoid confusion and to aid in the more systematic study of these important animals.

The following is a list of orders and suborders, beginning with the lowest:

1. **Thysanura.**—Silver-fish or silver moth, spring tails, bristle tails.
2. **Collembola.**—*Achorutes, Sminthurus.*
3. **Orthoptera.**—Earwigs, cockroaches, praying mantids, walking sticks, grasshoppers, katydids, crickets.
4. **Platyptera.**—
    1. Suborder **Corrodentia**—White ants or termites, psocids or bark lice and embiids.
    2. Suborder **Mallophaga**—Biting bird lice.
5. **Plecoptera.**—Stone flies.
6. **Ephemerida.**—May flies.
7. **Odonata.**—Dragon flies.
8. **Thysanoptera.**—Thrips.
9. **Hemiptera.**—Bugs.
    1. Suborder **Homoptera**—Cicadas, plant lice, scale insects, white flies.
    2. Suborder **Heteroptera**—True bugs.
    3. Suborder **Parasita**—Head and body lice.
10. **Neuroptera.**—Lacewings, including brown and green lacewings so well known as beneficial insects.
11. **Mecoptera.**—Scorpion flies (*Bittacus* sp.).
12. **Trichoptera.**—Caddis flies.
13. **Lepidoptera.**—Moths and butterflies.
14. **Coleoptera.**—Beetles and weevils.
15. **Diptera.**—Two-winged flies.
16. **Siphonaptera.**—Fleas.
17. **Hymenoptera.**—Horntails, sawflies, wasps, bees, and many small and large parasites.

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*This classification is based upon that of Dr. J. W. Folsom.

Because of their non-usefulness in such a work as this, the following orders will not be considered:

Thysanura
Collembola
Plecoptera
Ephemerida
Odonata
Mecoptera
Trichoptera
Siphonaptera

ORTHOPTERA (Order).

STRAIGHT-WINGED INSECTS.

EARWIGS, COCKROACHES, PRAYING MANTIDS, WALKING STICKS, GRASSHOPPERS, KATYDIDS AND CRICKETS.

All of the members of this order, with the exception of the praying mantids (*Mantidæ*) and certain exceptions among the earwigs (*Forficulida*), are destructive to vegetation and most of them are serious pests to cultivated crops. Though most of them possess four wings, a few genera and species have none at all. The fore wings are called tegmina and differ from those of most insects in that they are leathery being a means of protection for the delicate thin hind wings which are used for flying. All the members have strong and well developed mouthparts for biting and chewing. The metamorphosis or change from the young to the adult is gradual and scarcely noticeable. The first born always resemble the adult, with the exception that they have no wings and undeveloped sexual organs.

To follow out the systematic arrangement of this order, the families are usually arranged as follows:

1. **Forficulidæ*;
2. *Blattida*;
3. *Mantida*;
4. *Phasmida*;
5. *Acridiidæ*;
6. *Locustida*;
7. *Gryllida*.

While practically all of these are of great interest and often of economic value, only the last three are deemed of sufficient importance to be included in a work of this character. These will be considered in the order as given above.

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*The *Forficulidæ* are placed in a separate order Euplexoptera by many entomologists.

ACRIDIIDÆ (Family).

SHORT-HORNED GRASSHOPPERS OR TRUE LOCUSTS.

The insects of this family include the most destructive members of the entire order and are common practically everywhere. They are separated from the other families by their short antennæ, which are never as long as the body; by the three-jointed tarsi; and by the short plated ovipositor. The hind legs are large and long to enable them to travel rapidly by jumping. With the exception of a few species all have well-developed wings and are able to make long and continuous migratory flights.

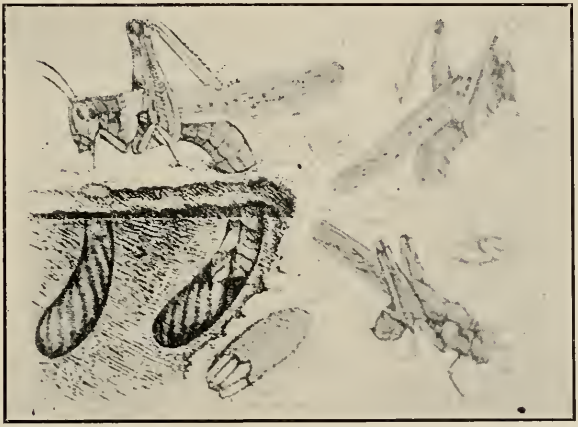

FIG. 12.—The Rocky Mountain Locust (*Melanoplus spretus*) laying eggs. (After Riley.)

The members of this family are very prolific and increase in such numbers as to cause great ruin to vegetation. Many species migrate long distances, leaving a trail of devastation in their wake. The eggs are usually laid at the bottom of a hole drilled into the soil by the abdomen of the female (Fig. 12). As the winter is passed in this stage, the eggs are thoroughly protected from cold and moisture by a fluid cement secreted by the female for this purpose. In the spring the young hoppers emerge from the holes and begin to feed upon the first green vegetation and develop very rapidly. In the early fall they begin to mate, the females depositing their eggs before winter.

Control.—The control of grasshoppers is often a perplexing problem, due to their great numbers and migratory habits. Their appearance is often so sudden as to take the farmer wholly unawares and the damage done before he can defend his crops. Extensive experiments on control work have been conducted by trained men all over the world, the results of which have made the hopper invasions less dreaded. The reclamation of arid lands and the extension of agriculture to the foothills and deserts have eliminated many of the old and favorite breeding places, and greatly reduced the size and numbers of migrations. In this State the most destructive species are controlled as follows:

Poisoned Bran.—In California the poisoned bran bait has proven exceedingly effective. This is recommended by J. S. Hunter (Bull. 170 Cal. Agrcl. Exp. Sta.), as follows:

Bran	40 pounds.
Molasses (cheapest)	2 gallons.
Arsenic	5 pounds.

The bran should be wet so that water can be just squeezed out of a lump held in the hand. After this, stir in the molasses and then the arsenic. Let stand over night and stir well before placing in the field, so as to allow the poison to penetrate every particle. The poison should be scattered in small piles, about the size of an egg, in front of the path of the hoppers throughout the infested area. In orchards bait should be placed at the trunk of each tree. This bait should be either occasionally moistened or renewed.

Criddle Mixture.—This is one of the poisons used in the East and Middle West with such effectiveness and is prepared as follows:

Paris green	1 pound.
Common salt	2 pounds.
Fresh horse dung	60 pounds.

The paris green is first mixed with water to form a paste and then thoroughly stirred into the horse dung with the salt. The mixture is then scattered in some such manner as is the poisoned bran.

Protecting Orchard Trees.—The general practice has long been to whitewash the trunks of trees to prevent the grasshoppers from crawling up into the trees. If occasionally renewed this wash does great good in this way and is worthy of recommendation.

A broad tanglefoot band near the base of the trunks will catch many of the hoppers but if not applied very thickly the larger and stronger ones will pull out.

Poison baits placed at the bases of the trees will keep most of the hoppers from attempting to ascend to the foliage.

Cultivation.—As previously stated the grasshoppers lay their eggs in the fall in small holes in the soil an inch or two deep. The eggs hatch in the spring and the young easily escape. Late fall or winter plowing from four to six inches deep will so cover the egg sacs as to make the escape of the newly hatched hoppers impossible. The greatest menaces are the places held by speculators, who are indifferent to the ravages of these pests. Such localities afford excellent breeding places and in every community where the hoppers are bad, steps should be taken to see that such places are plowed at least during the winter months.

A thorough harrowing or disking after a rain serves to fill up the burrows and to crush many of the egg masses.

Burning.—Another means of reducing the pests is to burn the grass or stubble of the breeding places or infested field when hoppers are the most plentiful or when the females are collecting on the breeding grounds to begin egg laying. The best time for firing is during the night when the hoppers are less active and are unable to escape the approaching flames by flight. Of course only waste stubble, or pasture lands, can be so treated, but these are usually the breeding places. Great care should always be exercised to see that sufficient help is ready to keep such a fire under complete control.

Hopper-dozer.—The use of the hopper-dozer has become an important factor in the control of grasshoppers, especially in grain and hay fields, in pastures and even in cultivated crops. The hopper-dozer is constructed as shown in Fig. 13. The back and sides are made of thin sheet iron or cloth and the pan at the bottom constructed to hold about two inches of kerosene. These dozers may be made any length but a two-horse size is the most practicable. They are simply drawn across the fields and capture the hoppers as the latter endeavor to escape their approach. Though the hoppers may escape from the kerosene bath they are doomed.

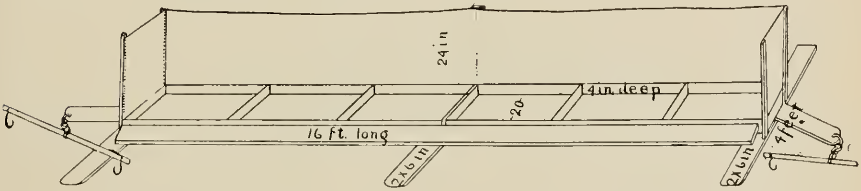

FIG. 13.—Plan of a very good hopper-dozer. (After Urbahns.)

The best time of operation is on warm days if possible, early in the season before the hoppers have acquired wings.

A brief description of some of the most common and destructive California species follows.

THE YELLOW-WINGED OR PELLUCID GRASSHOPPER.

Camnula pellucida Scudd.

(Fig. 14.)

General Appearance.—The adults are slightly over one inch in length and are quite variable in color, varying from light yellow to dark ashy brown, with well defined black markings and two amber lines down the angles of the tegmina, noticeable when resting. These lines merge about one third the distance from the base. The head and thorax are darker than the abdomen. The basal halves of the antennæ are light while the apical halves are dark. The first two pairs of legs and hind femora are concolorous with the body—the hind femora with darker markings, while the hind tibiæ are light yellow. The young are very dark in color, often almost black.

Life History.—This is one of the most famous migratory species, often flying in great swarms, and was formerly a serious pest in the states west of the Mississippi River and often those just east. The eggs are laid in small sacs in sandy or gravelly soils. They are deposited during August and hatch in May and June. The growth of the young hoppers is very rapid so that within a month they have acquired wings and are ready to migrate. The breeding places are often located in the higher altitudes, and the adults migrate to the lowlands, many remaining along the path to deposit their eggs for the following year. In the fall the species returns to old or selects new breeding grounds to deposit the over-wintering eggs.

Distribution.—Throughout the State, especially prevalent in the Sierra foothills from whence they migrate into the Sacramento and San Joaquin valleys. Considerable numbers were collected around Lake Tahoe during the months of July and August of last year.

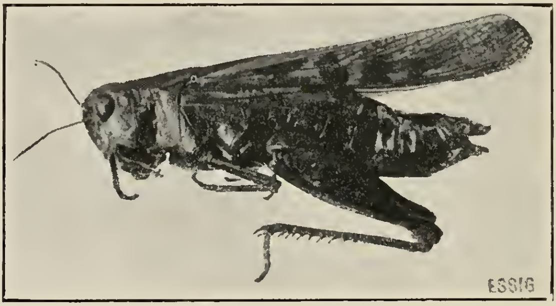

Fig. 14.—The yelow-winged or pellucid grasshopper, *Camnula pellucida* Scudd. (Original.)

Food Plants.—This species is especially destructive to the grasses, including oats, wheat, barley, etc. Alfalfa is seldom injured, not being a favorite food. At present no serious outbreak of this pest has been definitely recorded in California, though in the earlier days it must have done considerable damage to the wheat crops in the interior valleys.

THE VALLEY GRASSHOPPER.

Œdaleonotus enigma Scudd.

(Fig. 15.)

General Appearance.—One of the smaller species, the adults being about one fourth of an inch long. The general color is rich amber with reddish hue around the eyes. The dorsum and carinæ of the thorax are dark. The tegmina are mottled with black and dusky spots. The antennæ and first two pairs of legs are concolorous with the body, while the femora of the hind legs are richly marked with black and the tibiæ are pale blue. The young are nearly of the same general color, with the dark markings less pronounced.

Life History.—The holes in which the eggs are laid are usually drilled in hard or compact soil. The eggs are laid regularly and horizontally and cemented together, as well as being surrounded with a liquid cement which renders the mass waterproof. The young hatch the following spring, as soon as it becomes warm and they begin to reach maturity early in June. Pairing begins soon after and eggs are deposited from August to October. There are two forms of the adults, characterized by long and short wings. The species is very prolific and does much damage. It is only occasionally migratory.

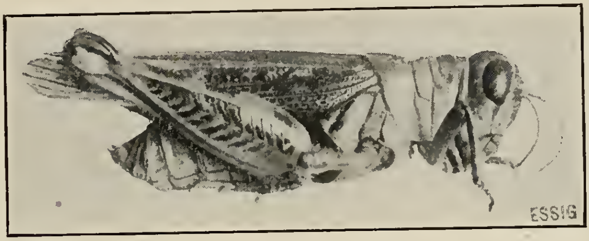

Fig. 15.—The valley grasshopper, *Œdaleonotus enigma* Scudd. (Original.)

Distribution.—Throughout the lower San Joaquin Valley especially in the Turlock region.

Food Plants.—All forms of vegetation, including the foliage of orchards and vineyards, uncultivated field crops, such as alfalfa, clover, grain, etc., and cultivated crops, such as vegetables, corn, potatoes, etc., are attacked.

THE DIFFERENTIAL GRASSHOPPER.

Melanoplus differentialis Thomas.

(Fig. 16.)

General Appearance.—This is one of the larger hoppers, averaging one and five eighths inches from front to the tip of the tegmina or wing covers. A very beautifully colored insect when fully matured. The head, thorax, abdomen and first two pairs of legs are amber or rich brown, the sutures being dark. The wing covers are brownish gray—the true wings being transparent. The hind femora are yellow with black cross lines, while the tibiæ and tarsi are bright red, the former with black spots near the outer base. The spines and claws are black. The antennæ are reddish with dusky tips. The nymphs are green.

Life History.—Egg-laying begins about the middle of the summer. The holes for the eggs are drilled into the soil in bare and vacant places, especially in alfalfa fields. From sixty to eighty eggs are laid by each female. They are protected from winter rains and freezes by an excretion of the female which makes the capsule containing them waterproof. They begin to hatch in the warmer spring months, appearing early in June and keep up their destructive work until August. The young green hoppers, as they mature, acquire wings and assume a yellowish tint, thus causing the belief that there are two distinct species. The largest brood appears early in the summer, and the greatest amount of damage is done by the first of August.

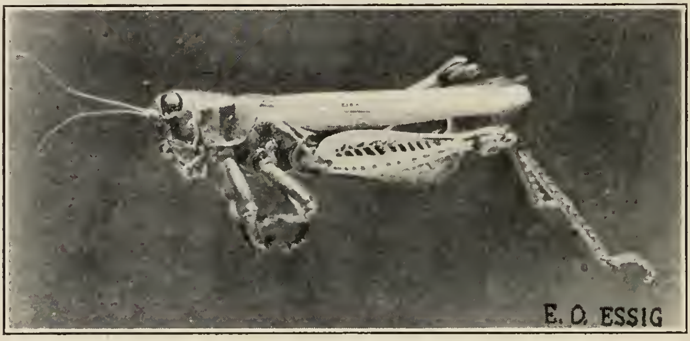

FIG. 16.—The differential grasshopper, *Melanoplus differentialis* Thomas. (Original.)

Distribution.—Especially abundant in the San Joaquin Valley, though the species has a somewhat wider range throughout the State. Outbreaks have been recorded at Newman and Los Banos in past years. This year it was especially abundant in Madera County.

Food Plants.—Practically all kinds of green vegetation, including most of the forage and truck crops. Especially destructive to alfalfa. Orchard trees and vineyards are also attacked, some trees and vines being completely defoliated and many killed.

THE CONSPICUOUS DEVASTATING GRASSHOPPER.

Melanoplus devastator conspicuus Scudd.

(Fig. 17.)

General Appearance.—This is one of the smaller hoppers, averaging about one inch in length. The general color is amber or brownish with dark markings on the sides of the prothorax, on the tegmina and hind femora on which there are three distinct spots and a dark tip. The hind tibiæ are distinctly blue at their bases, gradually becoming amber towards the tips. The hind or true wings are transparent. The antennæ are light amber. The young are lighter in color and usually without markings.

Life History.—A partially migratory species which at times works from the foothills to the cultivated lands below. The eggs are deposited in the ground in the foothills, which are the special breeding grounds. Late in June the hoppers often become very destructive and though they feed mostly upon the ranges, fruit trees and small crops in those regions are often completely destroyed. In the late summer and fall the adults collect in the breeding places and deposit their eggs for the next year's broods.

Distribution.—In the foothill regions of the San Joaquin Valley, especially below Mariposa.

Food Plants.—The food plants of this pest are about the same as for most grasshoppers and include grasses, foliage of deciduous trees, cultivated and wild, nearly all cultivated crops and succulent vegetation. Grain and hay crops usually suffer most from their attacks.

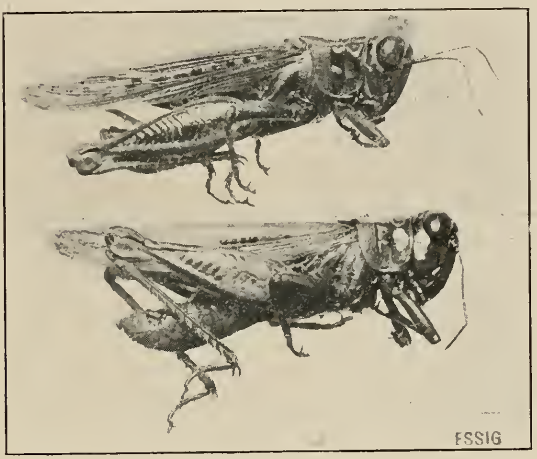

FIG. 17. The devastating grasshopper, *Melanoplus devastator conspicuus* Scudd. (Original.)

Control Measures.—Control is necessary only when this species develops the migratory habit. Its attacks are so sudden as to make control measures very necessary and prompt. In the fields the hopperdozers may be used. Burning over the breeding grounds is recommended, as the most effective remedy, but great care must be exercised to avoid range and timber fires. Such treatment affects only the next year's broods. Poisoning may be used effectually in cultivated areas.

THE PALE-WINGED GRASSHOPPER.

Melanoplus uniformis Scudd.

(Fig. 18.)

General Appearance.—This species is characterized by the light uniformly colored bodies, which vary from dark straw to amber. The wing covers are grayish. The tips of the hind femora have two long, lateral, dark spots, and there are indications of the three dark blotches usually present. The tibiæ of the hind legs are very pale blue. The length of the adult is slightly over one and one fourth inches. The young are slightly lighter in color.

Life History.—This is a truly migratory species, being very restless and hardly remaining long enough in one place to become harmful. The first migration occurs in the Turlock and Newman districts* during the early part of June. The swarms continue to move about through September. The young reach maturity slowly and pairing begins in August. The eggs are deposited in October and November and hatch as soon as the ground becomes warm the following spring.

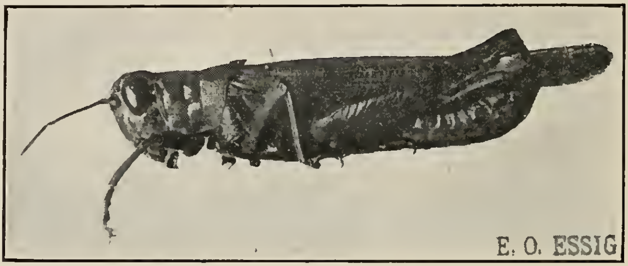

FIG. 18.—The pale-winged grasshopper, *Melanoplus uniformis* Scudd. (Original.)

Distribution.—Especially abundant in the central San Joaquin Valley, in the region southeast of Turlock, but the range comprises much of the central part of the State.

Food Plants.—Practically the same as for *Melanoplus differentialis*, though not so destructive to the crops.

LOCUSTIDÆ (Family).

THE LONG-HORNED GRASSHOPPERS.

KATYDIDS.

The members of this family are characterized by having long filiform antennæ, four jointed tarsi and a six-pieced, flat, sickle-shaped ovipositor. The usual color is pale or bright green though many members are quite dark. All are great singers. The wings when present are large but thin and delicate. Practically all of the species are vegetable feeders and while more or less destructive are not so much so as the short-horned grasshoppers (*Acridiidæ*).

The control of the members of this family is practically the same as for the short-horned grasshoppers.

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*Bull. No. 170, p. 5, Cal. Agrcl. Exp. Sta. 1905.

THE CALIFORNIA ANGULAR-WINGED KATYDID.

Microcentrum laurifolium Linn.

(Fig. 19.)

General Appearance.—Large green long-horned grasshopper or katydid, from one and a half to two and a half inches long. Easily distinguished from the ordinary grasshoppers by the long, thin antennæ and slender hind legs. The eggs are oval and flat, white in color, laid so as to overlap like shingles. They may be laid in a single row around the edge of the leaves or on the young stems (Fig. 21) or in double rows on the latter. The young katydids are bright green and appear to be all legs and antennæ. The adult females have a characteristic sickle-shaped ovipositor.

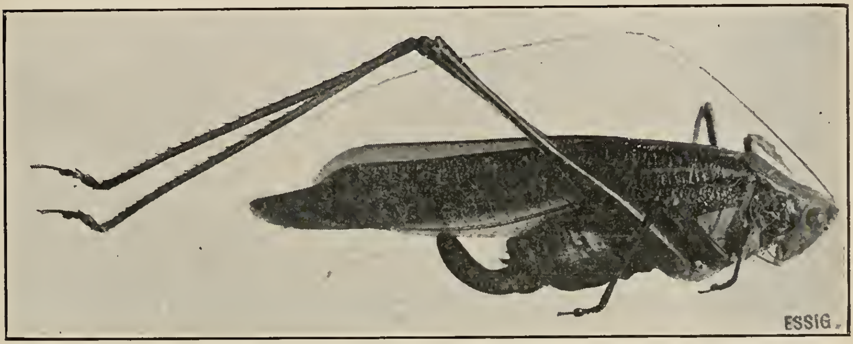

Fig. 19.—The California angular-winged katydid, *Microcentrum laurifolium* Linn. (Original.)

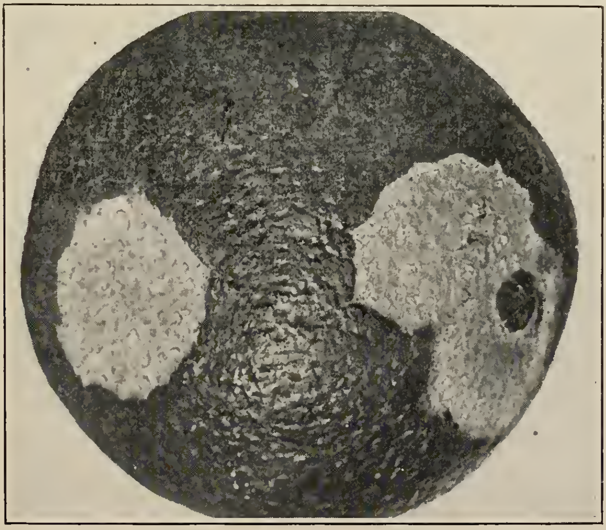

Fig. 20.—Orange showing work of katydid.

Life History.—The eggs are deposited in the fall and constitute the winter stage. In the spring the young katydids escape from the exposed ends and immediately begin work upon the foliage, continuing their destructiveness throughout the spring, summer and fall. The broods are uneven so all stages may be found throughout the summer.

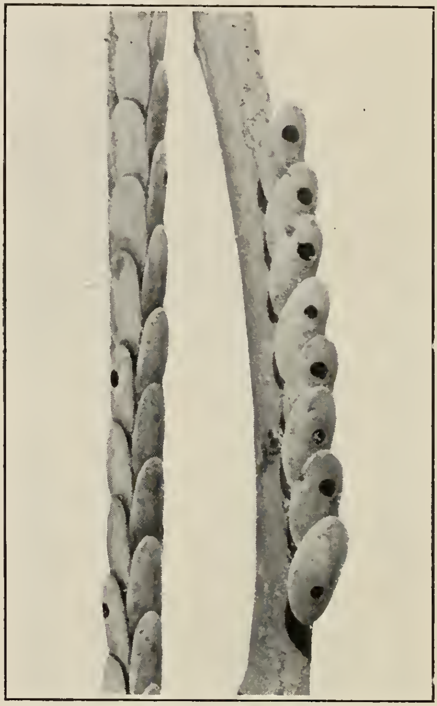

FIG. 21.—Katydid eggs, showing exit holes of the egg-parasite, *Eupelmus mirabilis*. (Original.)

Distribution.—Throughout the entire State, but especially common in the citrus-growing sections. More damage is done in the Sacramento Valley than anywhere else.

Food Plants.—Particularly destructive to orange trees. Usually the foliage is the only part affected, but occasionally they gnaw into the young fruit, producing deep and ugly scars, which render it unfit for market. (Fig. 20.)

Control and Natural Enemy.—The egg parasite (*Eupelmus mirabilis*) is practically responsible for the control of this pest and may be relied upon to keep it down to where great or excessive damages can not result. It is wise to collect the eggs during the winter and place them into boxes covered with screen. As the small parasites gnaw their way out of the egg through small holes at the top they may escape to continue their good work, while any young katydids that may hatch out cannot escape because of their long legs and antennæ. It is very difficult to secure colonies of the eggs without finding many showing the holes made by the parasites.

THE LONG-LEGGED GRASSHOPPER.

*[*Clinopleura melanopleura* Scudd.

(*Steiroxys melanopleura* Scudd.)

(Fig. 22.)

General Appearance.—This insect is one of the nearly wingless long-horn grasshoppers, the wings being reduced to mere pads on the back. The general color is light yellowish-brown with dark brown variations. The abdomens are slightly darkened on the sides; the outer surfaces of the hind femora are also dark. The lower portions of the pronotum are bright yellow; the legs are very long, the hind femora being over three times as long as the pronotum. The females are easily recognized by their straight ovipositor, which is abruptly pointed at the apex and is not as long as the posterior femora. The full-grown forms are from one and a quarter to one and one half inches long, the ovipositor making the female much longer.

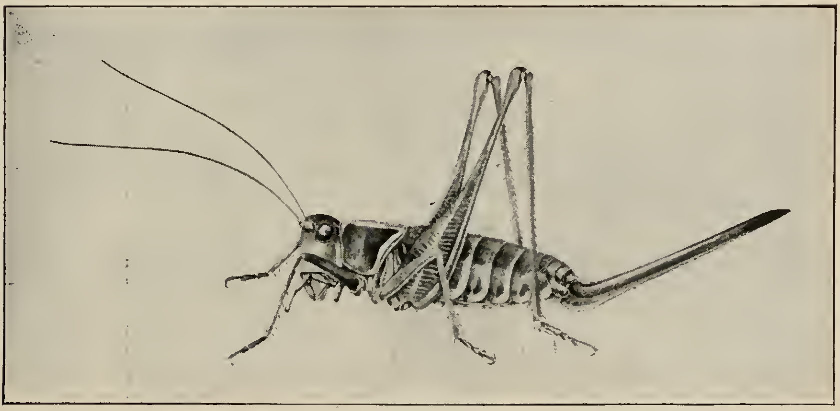

FIG. 22.—The long-legged grasshopper, *Clinopleura melanopleura* Scudd.. Female. (After Hunter. Courtesy Cal. Exp. Sta.)

Life History.—The life history of this species is not well known, but is probably as follows: The females deposit their eggs in the late fall upon various kinds of vegetation. The young, light-colored forms hatch in the spring and begin feeding in the grassy fields and woodlands immediately upon emergence and continue to become numerous until summer when mating and egg-laying begin, continuing until autumn.

Distribution.—This species is more often met with in the San Joaquin Valley and southern parts of the State, having been collected in Fresno, Los Angeles, San Bernardino and Tulare counties.

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*[*Clinopleura melanopleura* var. *infuscata* Caudell is smaller and darker than the above species and somewhat resembles *C. flavomarginata* Scudd., but smaller and with the lateral lobes of the pronotum more distinctly margined and yellow posteriorly.

Clinopleura flavomarginata Scudd., a dark brick-red and yellowish form closely resembling the long-legged grasshopper and *C. minuta* Caudell, also a dark species but much smaller than any of the others, also occur in the central and southern parts of the State.

Food Plants.—These hoppers, though not as destructive and numerous as the common grasshoppers, have done considerable to aid in the destructive work of the latter. They feed on various sorts of vegetation, especially forage crops, including grasses, alfalfa, clover, etc.

Control.—The control of this pest is practically the same as that outlined for grasshoppers (*Acridiida*).

THE SAND OR JERUSALEM CRICKET.

Stenopelmatus irregularis Scudd.

(Fig. 23.)

General Appearance.—The adults never have wings and are of a light brown or amber color, with the abdomen dark excepting an extreme posterior band around each segment, which is amber and gives a decided striped appearance. (Fig. 23.) The antennæ are long and filiform; legs large and strong. There are two noticeable horn-like processes on each side of the posterior end, which stand perfectly upright. They are light in color and slightly hairy. The ends of all spines are black. The length of the adults varies considerably, but the largest are one and three quarters inches long. This species is

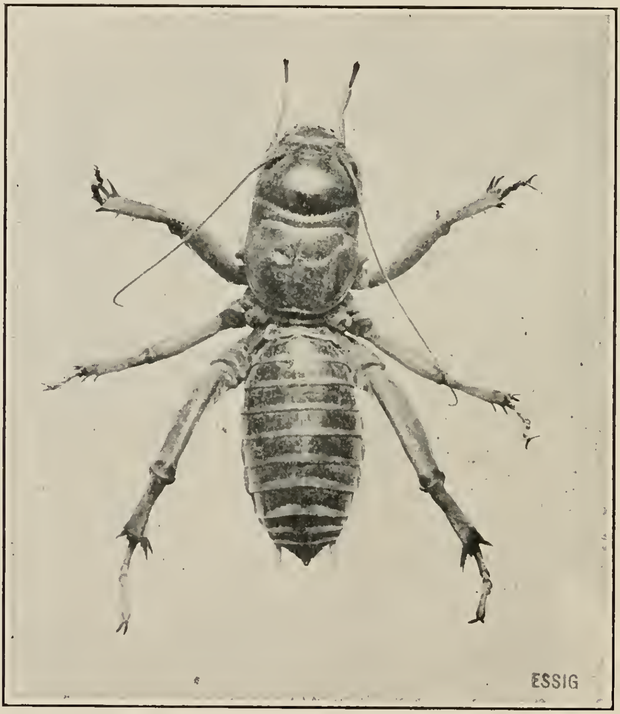


Fig. 23.—The sand or Jerusalem cricket (*Stenopelmatus irregularis* Scudd. Slightly enlarged. (Original.)

separated from others by having five inner spines above on the hind tibiæ, the third and fourth of which have the greatest interspace between them.

Life History.—The life history of this species is not well known, as practically its entire existence is spent underground. All stages, from young to adult, appear the same, except in size. They feed upon the roots of plants.

Distribution.—This species is more particularly confined to the central and southern parts of the State, though they probably also occur in the northern part, especially in the Sacramento Valley.

Food.—The feeding habits of these peculiar insects are not well known. Some are carnivorous, while others are believed to feed upon decaying vegetable or animal matter. However, we do know that they are often responsible for considerable damage to potatoes before they are dug. The tubers are gnawed so as to be unfit for keeping or selling. Occasionally a large proportion of the crop may thus be injured, but this is more likely to happen only in small places.

Control.—The most injury is done in fields placed under cultivation for the first time or lands left for some time to sod or pasture. Well cultivated fields seldom if ever suffer from the attacks of this pest. Clean cultivation around the fences so as to break up the breeding places will practically eliminate all possibilities of injury.

GRYLLIDÆ (Family).

CRICKETS.

The members of this family, like the *Locustidæ,* have long filiform antennæ, but the tarsi are three-jointed and the ovipositor is spear-shaped. Many of the species are wingless. When the wings are present they are deflexed on the outer edge and fold closely to the sides and back. This is also a musical family. All species are injurious to vegetation.

The common field crickets are most abundant and familiar. They seldom do enough damage to deserve special treatment here. The tree crickets are almost arboreal in habits and do considerable damage to economic plants by making incisions in the smaller branches and stems into which the eggs are deposited.

THE SNOWY TREE-CRICKET.

Œcanthus niveus DeGeer.

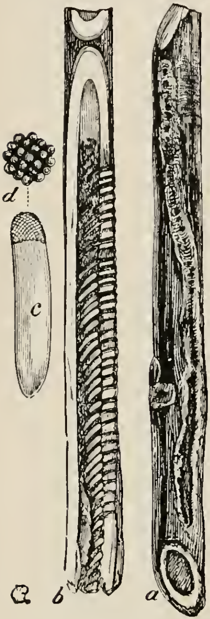
(Fig. 24.)

General Appearance.—The adult insects are slightly more than half an inch long and light yellow or greenish in color. The antennæ are very long and hair-like. There is one black dot on the face beneath each antenna. The females appear narrow, because the wings are folded along the sides and over the backs, while in the males they are spread out flatly on the back. The black-tipped ovipositor also helps to distinguish the female. The eggs are about one eighth of an inch long, slender, slightly curved and white. They are inserted in the stems of the host.

Life History.—The eggs are placed singly in the canes or twigs in the autumn and remain dormant during the winter. The first warm spring days cause them to hatch and the young, wingless, green crickets begin feeding upon plant lice or other soft-bodied insects. Throughout its entire life, from the time it leaves the egg until egg-laying commences in the fall the insect is working for the benefit of the farmer. By autumn all forms are mature and egg-laying begins, the adults disappearing soon afterwards.

Distribution.—Throughout the entire State.

Food and Host Plants.—The damage done by the snowy tree-cricket is due almost entirely to its method of puncturing the small stems and canes in egg-laying. It often happens that so many eggs are placed in the canes as to cause considerable loss. Raspberries and blackberries receive the most injury, though young deciduous fruit nursery stock is also often severely injured. The feeding habits of this species places it among the beneficial insects and partially offset the damage done in depositing the eggs. The young and old alike feed upon soft-bodied insects, principally plant lice, and due to their ravenous appetites they are able to consume great numbers of other injurious pests.



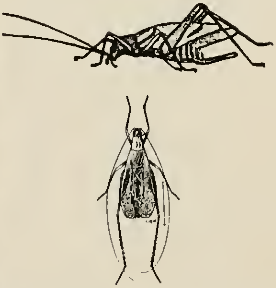


Fig. 24.—Left, eggs of *Œcanthus* sp. *a*, twig showing punctures; *b*, twig split open to show eggs; *c*, egg; *d*, cap of egg. Enlarged. (After Riley.) Upper right, female of *Œcanthus niveus* DeGeer. Lower right, male of *Œcanthus fasciatus* Fitch, which greatly resembles male of snowy tree-cricket. (After Lugger.)

Control.—The method of eliminating subsequent broods and attacks consists in cutting out all canes showing the characteristic signs of having been punctured for egg-laying (Fig. 24*a*). It has been said by many reliable authorities that the good done by the snowy tree-cricket in destroying injurious plant lice and other soft-bodied insects more than recompenses the farmer for the harm done and that only in rare cases should the eggs be destroyed, even after the injured canes or branches have been removed.

PLATYPTERA (Order).

The members of this order have direct or incomplete metamorphosis, the larvæ and nymphs not varying greatly in structure from the adults. The wings, when present are two pairs, membraneous, delicate, equal or front wings slightly larger. There are two suborders, *Corrodentia* and *Mallophaga.* Only the family *Termitidæ* of the *Corrodentia* will be considered here.

TERMITIDÆ (Family).

TERMITES OR WHITE ANTS.

(Fig. 25.)

These insects, though commonly called white ants, are not ants at all, being more closely related to the lower groups of insects rather than to the true ants. Some entomologists have placed them in a single order — *Isoptera.*

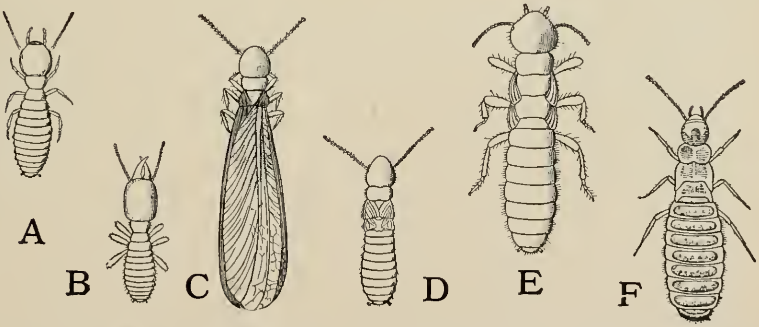


Fig. 25.—*Termes lucifugus* Rossi. *A*, adult worker; *B*, soldier; *C*, perfect winged insect; *D*, same insect after shedding the wings; *E*, young queen; *F*, old queen. (After Grassi and Sandias.)

The eyes of the termites are faceted or made up of many apparently individual eyes; antennæ 9–31 jointed; prothorax large and well developed; abdomen elongated with ten segments; wings long, slender, membraneous, equal and delicate. The habits are social, there being abortive female workers, soldiers, males and sexual females or queens.

THE COMMON TERMITE.

Termes lucifugus Rossi.

(Figs. 25, 26.)

General Appearance.—The workers of this species are rather small, being shown as natural size in Fig. 26. They are transparently white in color, the contents of the alimentary canal giving a yellowish or brownish cast. The head is darker yellow and mandibles brown. The soldier ants have large brown heads, comprising at least one third of their entire bodies. The queen ant is much larger than the other forms, while the males are small. It is claimed that there are no less than fifteen kinds of individuals in this species.

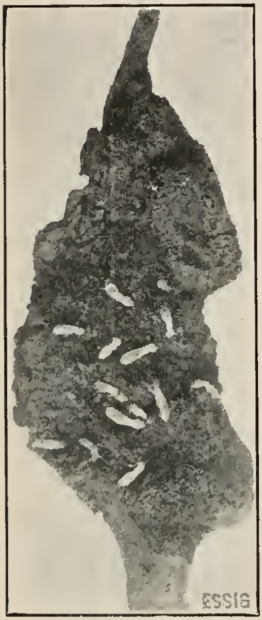


FIG. 26. — *Termes lucifugus* Rossi, working on roots of nectarine tree. (Original.)

Life History.—These termites usually live in dead or decaying wood but often work into the living and growing tissues. They make very extensive galleries through all parts and thus often destroying buildings, fences, etc., as well as fruit trees. The queen gives rise to all the young, which appear in great numbers, especially during the summer months. In the fall or autumn winged or migratory forms appear and often fly by thousands on dark days and towards evening. In habits and life history they greatly resemble true ants and bees.

Distribution.—This species may be found in almost every section of the State.

Food Plants.—As previously stated, these termites usually work upon dead or decaying wood, but then usually only in the presence of moisture. In the southern parts of the State these insects have often become destructive to fruit trees, working upon the roots underground and making galleries up the trunk. No doubt they usually begin to work in the decaying tissues but often continue into the healthy portions of the tree. Nectarines, peaches and apricots seem to suffer most, while citrus and other trees and plants are also attacked.

Control.—Due to their secluded work the damage is usually done before their presence is known and too late to effect a remedy. However, if close observations are made in infested districts and their work discovered the colony may be almost entirely exterminated by the use of a liberal dose of carbon bisulfid applied in cotton or a sponge directly within their burrows or under the base of the tree.

THYSANOPTERA (Order).

THRIPS.

The numerous species of the minute fringed-winged insects, known as thrips, are placed in a single order as given above. These insects, though exceedingly small, may be readily observed by simply shaking almost any flower, especially the sunflowers and their allies, into the hand and observing the small yellowish or brownish slender individuals crawling out in the palm of the hand. They hop and fly very readily. The eggs are laid upon the outside, or within the tissues of the plant. In the latter case the female inserts the egg with her sharp ovipositor. The insects have direct or incomplete transformations, the larvæ greatly resembling the adults. The pupæ of some species have a quiescent stage, thus differing from most insects having incomplete metamorphosis, in which this stage is very active, differing from the adults only by the small wing pads. Those species having a quiescent pupal stage are characterized by the larvæ going into the ground for pupation and remaining there during the winter, the adult insects emerging in the early spring. The mouth-parts are modified so that the insects chafe rather than bite, and due to their constant work and tremendous numbers are able to accomplish very disastrous results. They work principally upon the young buds and flowers, though they often do considerable damage to fruits and foliage.

In this State thrips are among the most serious pests, especially in the Sacramento and San Joaquin valleys, where thousands of dollars are spent each year in protecting the orchards.

The control measures vary somewhat and are given under each individual species. Several species have been known to be attacked by internal hymenopterous parasites, but the exact amount of this parasitism for the various species is not well known.

THE BEAN THRIPS.

Heliothrips fasciatus Pergande.

(Fig. 27.)

General Appearance.—The adult insect is black with head and thorax dark brown; antennæ are whitish with tips dark; legs are black and yellow; front wings are blackish with white base; posterior wings uniformly yellow with dark fringes. The young stages are lighter in appearance than the adult.

Life History.—According to Mr. H. M. Russell the insects hibernate in the adult stage only, under leaves, rubbish, etc. They begin to emerge about January and immediately begin egg-laying. The eggs are inserted in the leaves or tender stems. The young begin feeding soon after hatching. When ready to pupate the larvæ seek shelter under rubbish or in the ground, where the nymphal stage is completed and the adults emerge. There is an overlapping of broods so that during the summer months all stages may be found. A complete life cycle from egg to adult occupies about two months. The adults begin to hibernate during the months of October, November and December.

Distribution.—The bean thrips are distributed throughout the entire State. It was first collected by Geo. W. Harney, present horticultural commissioner of Yuba County, in 1894.

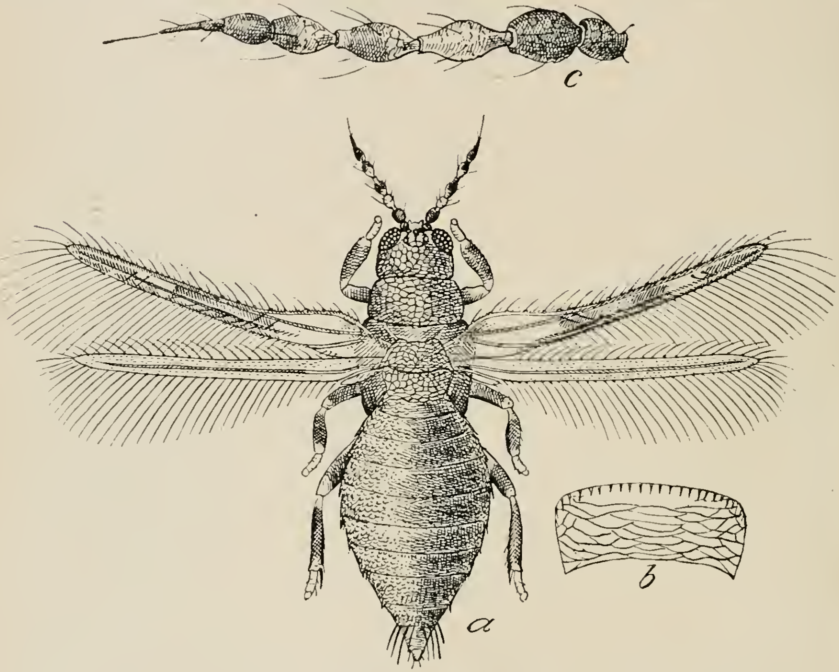


FIG. 27.—The bean thrips, *Heliothrips fasciatus* Perg. Greatly enlarged. (After Russell.)

Food Plants.—Due to its large numbers this insect has proved a serious pest to oranges, alfalfa, pear trees and various garden crops, the work being the same as that of other members of the family. In addition to these, the following plants are also attacked by this pest: beans, burr-clover, beets, radishes, pea, lettuce, wild lettuce, sow-thistle, wild heliotrope, *Euryptera lucida*, *Gnaphalium californicum*, *Mirabilis californica*, *Eunanus brevipes*, *Chenopodium murale*, wild sunflower, wild turnip, wild pea, nasturium, *Nicotiana glauca*, *Bidens pilosa*, *Verbascum virgatum*, *Polygonum aviculare*, *Crepis* sp. *Tacsonia mollissima*, tulip, pear, cotton.

Control.—Control measures for this pest are the same as recommended for pear, citrus or grain thrips, depending upon the plants which are infested.

A flour paste consisting of from six to eight pounds of cheap flour to one hundred gallons of water and applied thoroughly has given excellent results in controlling this pest upon truck crops, such as beans, peas, beets, etc., which have tender foliage.

THE GREENHOUSE THRIPS.

Heliothrips hæmorrhoidalis Bouché.

(Fig. 28.)

General Appearance.—The adult insect is characterized by having the antennæ eight-segmented and twice as long as the head, while the surface of the body is distinctly reticulated. The abdomen is yellowish brown, with head and thorax dark brown and antennæ, legs and wings colorless.

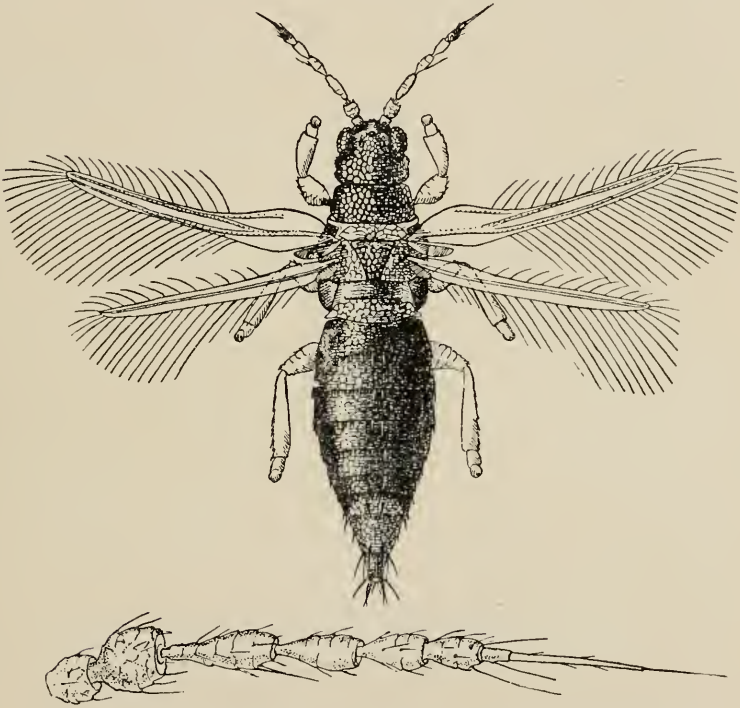


FIG. 28.—The greenhouse thrips (*Heliothrips hæmorrhoidalis* Bouché); adult female and antenna. (After Russell.)

Life History.—The very minute, bean-shaped, colorless eggs are inserted in the leaf tissues of the food plants, usually on the underside. They hatch in about ten days. Each female lays from ten to twenty eggs. The first hatched larvæ are colorless, with seven-segmented antennæ. As they age they become darker in color and the antennæ become eight-articulated. The larval and pupal stages occupy from four to six weeks. All stages feed throughout their life cycles. There are continuous and overlapping generations, estimated by H. M. Russell to be twelve a year.

Distribution.—In greenhouses throughout the State. Also abundant in the open, especially in the central and southern parts of the State.

Food Plants.—Citrus, azalea, *Aspidium,* crotons, dahlias, phlox, verbena, pink, ferns, vines, cherry, laurel, laurestinus, palms, *Ficus* sps. *Pellæa hastata, Liliaceæ,* fuchsia, mango, begonia, cattleya, grape, Norfolk Island pine, smilax. On citrus the fruit as well as the foliage is scarred.

Control.—Sprays recommended for pear thrips (*Euthrips pyri*) are also applicable for this pest, but in spraying tender greenhouse plants these should be weakened to two thirds normal strength. In spraying for the greenhouse thrips on citrus trees, use the formulæ recommended for citrus thrips (*Euthrips citri*).

Fumigating may be employed if the greenhouses can be made reasonably tight, using one third to one half of an ounce of potassium cyanide to every one hundred cubic feet of space, proceeding as directed for orchard fumigation work.

Natural Enemies.—Mites prey upon this species to a considerable extent, but render little reliable aid.

THE GRAIN OR STRAWBERRY THRIPS.

Euthrips tritici Fitch.

(Fig. 29.)

General Appearance.—Very minute, being from 0.029 to 0.031 of an inch in length. The color is yellow, with orange-tinted thorax.

Life History.—The eggs are very minute, globular in shape and red in color. They are inserted within the tissues of the host and hatch within a few days. The nymphs or young greatly resemble the adults, and begin to feed at once. The principal damage is done to the blossoms of the host. Strawberries especially suffer from their attacks. According to Professor Quaintance, the pistil is the portion of the blossom destroyed. The winter is probably passed in the soil, as in the case of the pear thrips (*Euthrips pyri*).

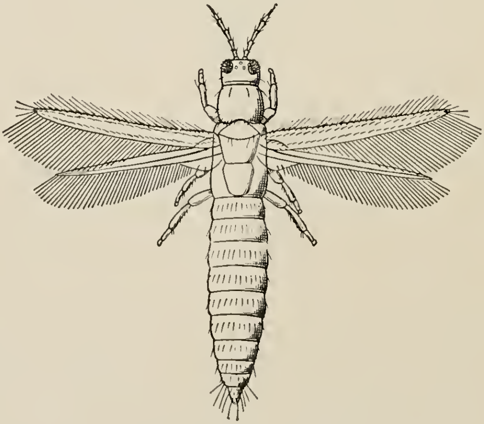


Fig. 29.—The grain or strawberry thrips, *Euthrips tritici* Fitch. (After Folsom.)

Distribution.—Throughout the entire State.

Food Plants.—Strawberry, orange, rose, lilac, alfalfa, grass, California sage (*Artemisia californica*) and manzanita.

Control.—This insect is seldom destructive enough to warrant control, but sometimes this is necessary. The sprays used for pear thrips (excepting whitewash) are equally effective in controlling this pest.

THE CITRUS THRIPS.

Euthrips citri Moulton.

(Fig. 30.)

General Appearance.—The adult thrips are orange-yellow in color, with the thorax and the second antennal segment orange-brown. They are very minute; so small as to be scarcely observed by the average orchardist, being less than one thirtieth of an inch in length and one one-hundredth of an inch in width. The presence of this insect is

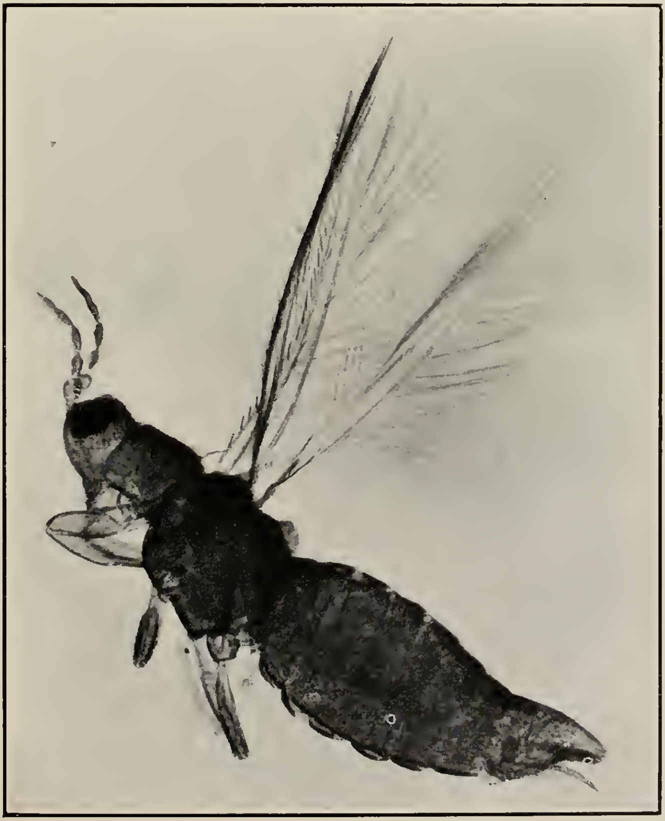


FIG. 30.—Citrus thrips (*Euthrips citri* Moult.). Photomicrograph of adult female. (Photo by Arizona Agricultural Experiment Station.)

usually ascertained by the work, which consists in searring the fruit in such a way as to form nearly regular circles around the stem and blossom ends, although these scars may extend almost over the entire surface. They also cause a characteristic crinkling and thickening of the young citrus foliage, just as the buds are unfolding.

Life History.—The winter is spent in the adult form, which hibernates in various protected places. The thrips become especially abundant about the time the citrus trees are in bloom and begin their work as soon as the petals fall and continue throughout the summer. The eggs are laid from May to August, hatching in six or ten days. The larvæ greatly resemble the adults but are at first somewhat lighter in color. In from six to eight days they change into the pupal stage, and in another three to five days become adult insects. The entire life cycle, from the laying of the egg to the beginning of the egg-laying of the adults of the second generation, is about twenty days. There are from eight to ten generations a year in the San Joaquin Valley, as estimated by Jones and Horton.

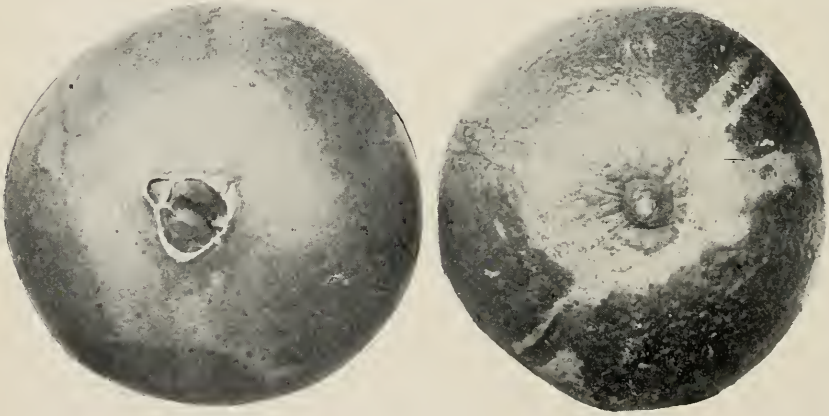


FIG. 31—Oranges showing the work of the citrus thrips. (U. S. Dept. Agrcl.)

Distribution.—Up to the present time the distribution of the citrus thrips is limited to the citrus sections in the San Joaquin Valley, along the western border of the Sierra foothills. This includes the Porterville and Bakersfield citrus belts.

Food Plants.—Citrus, *Punica granatum* (pomegranate), *Vitis vinifera* (European grape varieties), *Schinus molle* (California pepper tree), "umbrella tree," *Pyrus communis* (pear), *Prunus armeniaca* (apricot), *Prunus persica* (peach), *Prunus domestica* (European plum varieties), *Salix* sp. (willow), *Rumex* sp. (dock), *Portulaca oleracea* (purslane), *Olea europæa* (olive), *Rubus idæus* (European raspberry), *Rosa* sp. (rose), *Solanum* sp. The work upon oranges sometimes results in great losses. Fig. 31 shows characteristic chafing.

Control.—So far the best results in controlling the citrus thrips have come from spraying; experiments being conducted in California and Arizona with very good results. Two sprays were used in the work, lime-sulphur diluted at the rate of one part to eighty parts of water, and tobacco extract (40 per cent nicotine) diluted one part to eighteen hundred parts of water. The lime-sulphur causes slight burnings, but otherwise is as effectual and much less expensive than the tobacco extract. Four applications are recommended: the first just after most of the petals have fallen; the second in ten to fifteen days after the first; the third from three to four weeks after the second and the fourth during the months of August or September, when the thrips are numerous on the foliage. In spraying for this insect it is advisable to use angle nozzles and from 175 to 200 pounds pressure, care being taken that every portion of the tree is thoroughly drenched.

THE PEAR THRIPS.

Euthrips pyri Daniel.

(Fig. 32.)

General Appearance.—The eggs are very minute, white and bean shaped. They are embedded in the tender tissues of the host. The first born larvæ are white, with distinct red eyes, and move slowly. They are often very thick on the trees and are known as "white thrips." Pupation takes place in the ground, the pupæ being white and seldom met with except by careful investigation. The adult insect is dark in color, varying from an amber to a dark brown or almost black. The presence of this species is usually told by ravages on the tender tissues of the expanding flowers and leaf buds and later by the attacks on the young fruit. In badly infected orchards the buds often fail to open and the whole orchard may present a brown fire-swept appearance.

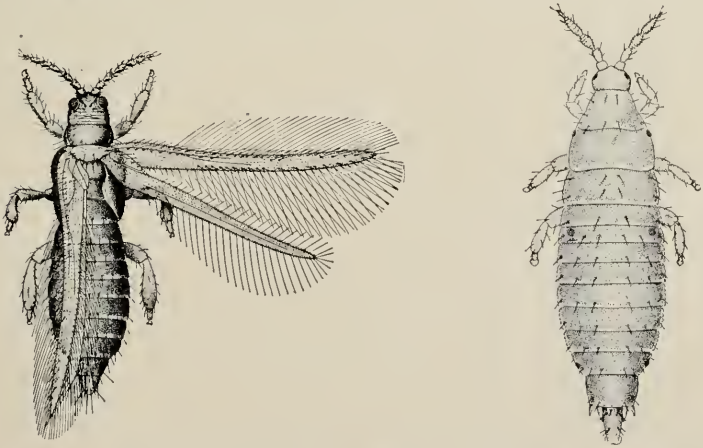


Fig. 32.—The pear thrips (*Euthrips pyri* Dan.). Adult female and nymph. (After Moulton.)

The fruit may be scabbed and curled or otherwise deformed by the constant chafing.

Life History.—As stated above, the eggs are inserted in the stem, leaf or small fruits of the host. They hatch in from four to five days, the larvæ or "white thrips" beginning to feed at once and to do damage. When full grown, which takes from two to three weeks, they drop to the ground and after penetrating several inches enclose themselves in a small cell, where they remain throughout the transforming or pupal period. This period usually begins about September and continues throughout the months of October, November and December, when adult insects are formed. These remain in the ground until February before emerging. The transformation from the larval to the adult stage occupies several months, the slow growth being probably due to the cold winter season.

Distribution.—The pear thrips is distributed throughout the Sacramento and San Joaquin valleys, and particularly in the following counties: Santa Clara, Alameda, Contra Costa, San Joaquin, Solano, Sacramento, Yolo, Napa and Sonoma. It has also been reported from the Sierra foothills in Placer County.

Food Plants.—This insect is particularly a deciduous tree pest and works great damage upon the leaf and flower buds as well as the young fruit. The initial damage is done just before or after blossoming time. The pear suffers probably more than any other tree due to ravages of this insect, although prunes and plums are also severely attacked. Peaches, apricots and almonds also receive serious damage some seasons. The following are other hosts of this pest: apple, cherry, fig, grape and English walnut.

Control.—**Government Formula.*—"The formula which has given the best results is made up of the 3 per cent distillate oil emulsion, to which is added from 1 per cent to 1⅔ per cent of tobacco extract No. 1 (black leaf containing 2.75 per cent nicotine) or tobacco extract No. 2 (sulphate of nicotine or black leaf 40), which is 40 per cent nicotine, at the rate of one part to from 1,500 to 2,000 parts of the spray mixture. The distillate oil emulsion may be obtained from several dealers in chemical and spraying supplies, or may be made at home. By the use of the homemade emulsion, a considerable proportion of the cost of spraying is saved and, what is more important, the quality of the emulsion is above reproach, when good materials are properly used in its manufacture."

Whitewash.—Mr. Earl Morris, horticultural commissioner of Santa Clara County, has had remarkable results in controlling pear thrips on pear trees by the use of a whitewash spray. His work covers a period of two years. The trees were sprayed with thick whitewash when the buds were just beginning to open. Some of his results as published in Bull. No. 238, Cal. Agrcl. Exp. Sta. are as follows:

"We used eighty (80) pounds of quicklime for one hundred (100) gallons of spraying material. The whitewash was strained through a one fourteenth (1-14) inch mesh wire screen and the same sized screen used on the suction hose of the pump. The ordinary Bordeaux nozzles worked well, but it was necessary to enlarge slightly the opening in the disks of vermorel type nozzles. We found it very important to have the lime properly slaked. Good lime properly slaked is of creamy consistency, with a negligible amount of grit. It forms a smooth, uniform, creamy coating on the tree. An attempt to use improperly slaked lime will usually result in complete failure. No amount of written instruction will teach one to slake lime. The knowledge must come from actual work with some one who has had the experience.

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*From G. E. Merrill, M. B. Cal. Hort. Com., Vol. I, No. 2, p. 54.

In orchard practice we found it convenient to have our slaking vat, which was 1 by 4 by 6 feet, elevated about three feet, with one end slightly lower than the other. In the lower end we arranged a sliding door through which the whitewash flowed by gravity into a containing vat. The lower vat was shorter, narrower and deeper than the slaking vat to facilitate the removal of the material to the spray tank. Between the two vats we arranged a piece of window screen, of one fourteenth inch mesh, supported by chicken fencing, through which the whitewash passed in flowing from the slaking vat.

The cost of material ranges from one (1) to one and one half ($1\frac{1}{2}$) cents per gallon, depending upon the cost of lime and labor. One application proved sufficient to protect the blossoms and permit setting of fruit. We did not find it necessary to spray a second time for larvæ, although in the first experiment enough larvæ appeared to lead us to believe that in some cases a second spraying would be necessary with some good contact spray."

THE ONION THRIPS.

Thrips tabaci Lindeman.

General Appearance.—The adult female is pale yellow in color with an elongated dusky spot on the dorsal surface of the middle thoracic segment. The length of the body varies from 1 to 1.2 mm. The eyes are brown, while the antennæ and legs are dusky. The wings are faintly yellowish, their fringes being dusky. The antennæ are seven jointed. The male larvæ are somewhat smaller than the female and of a darker color and often with a greenish tint. The eyes are red.

Life History.—The life history of this pest has not been thoroughly worked out, but no doubt greatly resembles those previously described.

Distribution.—This species is generally distributed throughout the entire State.

Food Plants.—The onion thrips is especially destructive to onions grown for seed. It damages the seed buds before the seeds have hardened and in many instances causes a complete failure of the seed crop.

It is also destructive to roses, carnations and other flowers (wild and cultivated), grasses, fruit blossoms and truck crops.

Control.—Nicotine extracts or the Government formula as recommended for pear thrips are efficient control methods for this species. The thrips are most active on the outside of the buds early in the morning, so that is the best time for applying a spray. The flour paste as recommended for the bean thrips is also applicable to this species.

HEMIPTERA (Order).

HALF-WINGED INSECTS.

CICADAS, LEAF-HOPPERS, TREE-HOPPERS, PLANT LICE, SCALE INSECTS AND TRUE BUGS.

This is one of the largest orders of insects as well as one of the most destructive known. There are nearly twenty thousand species.

The term Hemiptera comes from the fact that the fore wings of one of the suborders are thickened at the base, the tips being membranous and overlapping, thus appearing like half wings. Not all of the members possess these thickened wings, in fact a great many of them have no wings at all. This is specially true of some plant lice and of the female scale insects. The mouth-parts are formed for piercing and sucking and not for chewing. The metamorphoses are incomplete; that is, the young and nymphs differ from the adults only by the lack of wings in those species having well developed wings, while the young in those individuals not having wings appear almost identical with the adults.

The order Hemiptera is usually divided into the three following suborders: *Homoptera, Heteroptera* and *Parasita* or *Anoplura*, each of which will be considered separately.

HOMOPTERA (Suborder).

This suborder includes insects of the order Hemiptera, all of which, without exception, are very destructive to plant life. Wherever wings are present they are usually membranous and held roof-like over the body when at rest. The front of the head is bent under so as to touch the bases of the fore legs.

The families of this suborder are:

Cicadidæ (Cicadas).
Fulgoridæ (Lantern flies).
Membracidæ (Tree-hoppers).
Cercopidæ (Spittle insects).
Jassidæ (Leaf-hoppers).
Psyllidæ (Jumping plant lice).
Aphididæ (Plant lice).
Coccidæ (Scale insects).
Aleyrodidæ (Mealy wings or white flies).

The *Fulgoridæ* and *Cercopidæ* will not be considered here.

CICADIDÆ (Family).

CICADAS.

The cicadas are well-known insects, being commonly called harvest flies or locusts in the eastern states. The proboscis rises plainly from the head; there are ocelli present; the males have musical organs; feet with three segments and the antennæ are very small and bristle-like. The eggs are laid by the female in small twigs, punctures being made by the ovipositor for their insertion. The damage is caused by these egg-punctures. The young larvæ hatch within a few weeks and continue throughout their existence under the ground, where they remain for two or more years, depending upon the species: the so-called 17-year locusts requiring about seventeen years in which to transform from the larva to the adult. The pupa stage is passed in a small cell, also in the earth. When ready to change into the adult the pupa or nymph leaves the ground and crawls up some tree or shrub. The back splits and the adult issues. These insects appear in such great numbers during certain years as to become terrible pests, their depredations being known as plagues. There are many species in California, though none of them are as destructive as the 17-year locusts or the periodical cicada of the eastern states.

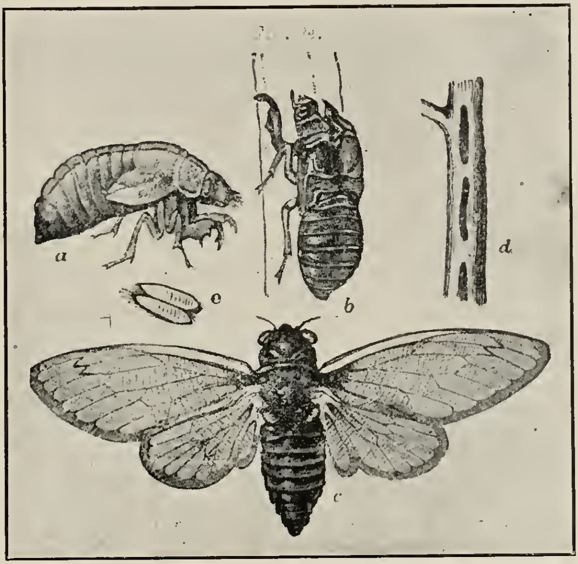

FIG. 33.—The periodical cicada. (*Tibicen septendecim* Linn.). *a*, pupa ready to transform; *b*, old pupal skin; *c*, adult; *d*, egg-punctures; *e*, eggs. (After Riley.)

MEMBRACIDÆ (Family).

TREE-HOPPERS.

The membracids are rather small insects and generally characterized by the prolongation of the prothorax which covers nearly the entire abdomen. The antennæ are minute and bristle-like; the beak plainly inserted in the head and feet with three segments. The most common species of this family in California is the Buffalo tree-hopper.

THE BUFFALO TREE-HOPPER.

Ceresa bubalus Fab.

(Fig. 34.)

General Appearance.—A small green hopper, scarcely one fourth of an inch long. The body is distinctly thin and tall, with prothorax widest in front and two horns above the head.

Life History.—The females deposit their two or three hundred eggs in large holes made through the bark of the limbs with their saw-like ovipositors. They usually select the two or three years' growth, which they often completely kill. The wingless nymphs emerge in the spring, having hibernated over the winter in the eggs, and begin feeding upon the leaves.

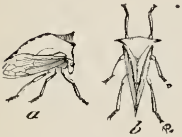

Fig. 34. — The buffalo tree-hopper, *Ceresa bubalus* Fab.

Distribution.—Throughout the entire State.

Food Plants.—The principal injuries are due to the puncturing for egg laying in the smaller limbs of various trees; this process being very destructive to nursery trees. Deciduous fruits as well as many other trees and shrubs are attacked in this way.

The insects feed upon all kinds of succulent vegetation, including vegetables and weeds.

Control.—Control measures are very difficult and impracticable, due to the wide distribution and great variety of food plants, but in cases where great damage is done in making the egg punctures in the twigs, the pest may be reduced for the following year by an application of kerosene or distillate emulsion as soon as the young appear. The cutting out of punctured branches during the winter and practicing clean culture also aid in checking their ravages.

JASSIDÆ (Family).

LEAF-HOPPERS.

The leaf-hoppers are also small insects and are specially active, being able to jump very freely and great distances. They greatly resemble the tree-hoppers but the prothorax does not extend back over the abdomen. The hind tibiæ have two very characteristic rows of spines below. The members of this family are exceedingly numerous and may be found upon most any kind of vegetation. There are two common and destructive species in California: the apple leaf-hopper and the grape leaf-hopper.

THE APPLE LEAF-HOPPER.

Empoasca mali LeB.

(Fig. 35.)

General Appearance.—The presence of the insect is made known by the curling and twisting of the infested leaves, especially on nursery stock: it being primarily a nursery pest. The adult insect is pale yellowish-green in color, with white marking and is about one eighth of an inch long. The young appear much like the adults except that they lack wings.

Life History.—The winter is passed both in the adult and egg stage. The winter eggs are white, very delicate and curved in the middle. They are inserted under the bark of young apple trees (preferably under bark of two or three years' growth). These eggs hatch in the early spring so that the young nymphs and hiberating adults attack the first green foliage. During the summer, eggs are deposited in large numbers on the food plants in the leaf petioles or in the larger veins. Favorite places are the leaf petioles of apple trees and alfalfa. The position of the egg under the bark or epidermis is made known by a slight swelling of the surface.

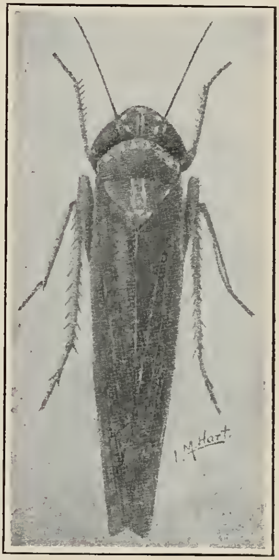

Fig. 35.—The apple leaf-hopper, *Empoasca mali* LeB. (After Forbes.)

Distribution.—Throughout the State; seldom becoming a serious pest in any locality, though occasionally it may do great damage.

Food Plants.—As previously stated, the apple leaf-hopper is primarily a nursery pest affecting especially young apple trees, thus dwarfing them. The work is particularly on the leaves. Besides the apple it feeds upon currant, gooseberry, blackberry, pear, cherry, plum, thorn-apple, black walnut, grapes, cottonwood, elm, birch, maple, box-elder, hazel, choke-cherry, sumach, oak, syringa, snowball, canaigre, basswood, buckthorn, rose, buckeye, corn, beans, potatoes, sugar beet, clover, grasses, buckwheat, dahlia, rhubarb, hemp, alfalfa, oats, celery and hollyhock. Without doubt other plants are also attacked.

Control.—The difficulty of control lies in the impossibility of killing the eggs without injuring the young trees. Successive sprayings with the oil emulsions, whale oil soap solution of 1 pound to 8 gallons of water, or tobacco decoctions, as often as the young become apparent, will prevent serious attacks and hold the pest in subjection. Affected nursery stock should be thoroughly dipped in such solutions before shipping. To prevent attacks nurseries should not be located near orchards or fields in which the hopper breeds. All food plants should be kept out of the nursery. Sticky shields and hopperdozers may be used with good effect.

Natural Enemies.—The most effective natural enemy is the small dark bug (*Triphleps insidiosus* Say), which preys upon the nymphs by puncturing their bodies and extracting the contents.

The larvæ of the green lacewings also prey upon the young hoppers.

THE GRAPE LEAF-HOPPER.

Typhlocyba comes Say.

(Fig. 36.)

General Appearance.—The adult insects are very small, scarcely more than one eighth of an inch long. During the summer they appear light yellow with the wing covers or elytra mottled with red. As the season advances the color becomes darker until winter it is dark red—this change is due to the increasing brightness of the red markings, which are very faint during the summer months. The young appear very much like the adults, excepting that their wings are not fully developed and there are less of the red markings.

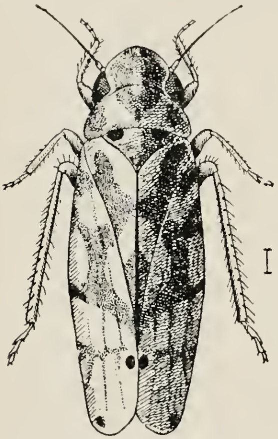

FIG. 36.—The grape leaf-hopper. Much enlarged. (After Johnson.)

Life History.—The eggs are bean-shaped and so small as to be almost microscopic. They are inserted just beneath the epidermis on the underside of the grape leaves and hatch in from fifteen to twenty days. The young nymphs begin at once to feed upon the first appearing foliage by extracting the juices from the leaves with the sharp beaks. There are two broods a year—winter and summer. The adults of the former hibernate and begin feeding upon the first foliage in the spring. During May they begin egg-laying, which gives rise to the summer brood. This brood grows very rapidly and lays eggs within a few weeks, dying off in the fall. Their eggs give rise to the coming winter brood. Thus the destruction may begin in May and end only when all of the leaves have fallen.

Distribution.—Throughout all of the vine-growing sections of the State. Especially abundant in the San Joaquin and Sacramento valleys.

Food Plants.—The principal and practically the only food during the summer months is the foliage of the grape, but during the winter many other plants are attacked, such as grasses, clover, alfalfa, mustard, ragweed and filaree.

Control.—A spray containing .02 of one per cent nicotine has proven to be the most effective contact insecticide for this pest. This must be applied when the nymphs begin to appear about the first of June, and great care taken to drench the under sides of the leaves. High pressure is necessary for good work.

Screen cages have been used very successfully in many localities in the State. Plowing and cultivating close to the vines and practicing clean culture aid in reducing the numbers.

Natural Enemies.—So far no internal parasites of this pest are known. The larvæ of the California green lacewing (*Chrysopa californica* Coq.) devour the young nymphs. Ladybird beetles also prey upon the young, but are of little consequence in the matter of control.

PSYLLIDÆ (Family).

JUMPING PLANT LICE.

The adults of the members of this family greatly resemble minute cicadas and are exceedingly like the large winged plant lice. They differ from the former in having the proboscis rising from the middle of the sternum and being much smaller, and from the latter in having the hind femora greatly developed, enabling them to jump freely. The pupæ are also characterized by the large and conspicuous wing pads. These insects, like plant lice, feed upon the tender foliage and bark of various plants. The most important member of this family in California is the pear psylla.

THE PEAR PSYLLA,

Psylla pyricola Foerst.

(Fig. 37.)

General Appearance.—Adults are small, orange yellow, jumping insects, not unlike miniature cicadas. More common than the adults are the nymphs, which are queer looking creatures with wide flat bodies and large heads. The general color is orange with dark striped

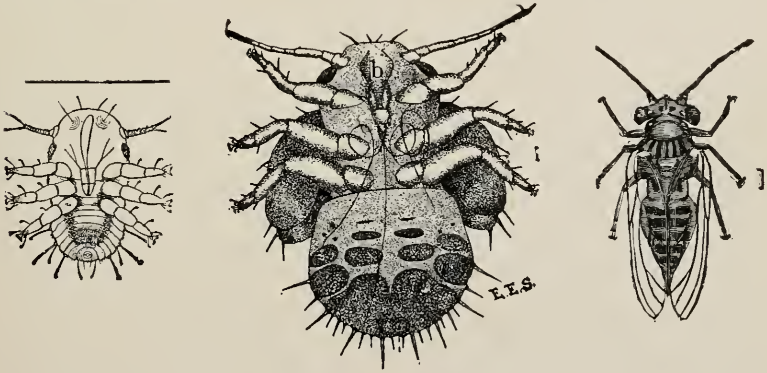

Fig. 37.—The pear psylla (*Psylla pyricola* Foerst). Young, nymph and adult. (U. S. Dept. Agrcl.)

thorax and blackish-brown abdomen. In the mature winged form the abdomen is greenish.

Life History.—The insects appear with the first healthy growing shoots, which they attack vigorously. They increase rapidly and often do great damage. All stages are to be found throughout the summer months.

Distribution.—Throughout the State, especially in the Sacramento Valley.

Food Plant.—The pear.

Control.—Same as for plant lice (*Aphididæ*), consisting of soap and emulsion sprays.

Natural Enemies.—The two-spotted ladybird beetle (*Adalia bipunctata* Linn.) and the green lacewing (*Chrysopa californica* Coq.) feed upon the eggs and larvæ of the pear psylla.

APHIDIDÆ (Family).

PLANT LICE.

The members of this family comprise one of the most important groups of destructive insects known. Every one is familiar with the soft-bodied winged and wingless lice which gather so abundantly upon all sorts of plants. The proboscis appears to rise in the middle of the sternum, the legs being rather long and slender; the wings when present are membranous and with few veins. Many of the females of this family have the power of producing living young without sexual intercourse, though true sexual forms usually appear sometime during the life cycle. Winged or migratory forms also appear. Some species live almost entirely underground while others are aerial in habits. As this family plays such an important part in the role of insect pests, we are including a large number of the most common species.

The life history of the green apple aphis (*Aphis pomi* De Geer) is given as an example on page 67.

METHODS OF CONTROL.

Plant lice are more subject to the attacks of other insects than perhaps any other one group of insects, but several species are by no means held in subjection by these natural enemies. In considering methods of control, then, we should take into account the natural as well as the artificial.

Natural Enemies.

Three families of insects are recognized as effectual predaceous enemies of plant lice. They are, *Syrphidæ*, *Coccinellidæ* and *Chrysopidæ*.

Syrphidæ. The larvæ of the syrphid flies are legless, worm-like animals, which are usually found among the plant lice upon which they feed. These larvæ vary from brown, yellow, or orange to dark green in color, according to the species. They are true maggots, with one end blunt and the other pointed. In feeding, they clasp their support by the blunt end, lift the plant louse bodily into the air with the pointed end and suck out the juices. The most common adult insects have yellow bodies with dark transverse stripes across the abdomen. The small syrphid (*Allograpta obliqua* Say), the very large syrphid (*Lasiophthicus pyrastri* L.) and *Syrphus americanus* Wied. are common in California.

Coccinellidæ. The work of the ladybird beetles on plant lice is known to all. The red ladybird beetles (*Cycloneda sanguinea* Linn. and *Coccinella californica* Mann.), the black-spotted ladybird beetle (*Hippodamia convergens* Guer.), *Hippodamia ambigua* Lec., *Megilla maculata* DeG., the eyed ladybird (*Olla oculata* Fab.), *Olla abdominalis* Say and the two-spotted ladybird (*Adalia bipunctata* Linn.) are the most common California species.

Chrysopidæ. One of the most common insect predators, preying on all sorts of soft-bodied insects, is the common green lacewing, called aphis lion because of its destructiveness to all plant lice. The eggs, larvæ, pupæ and adults are to be found everywhere in the fields, woods and orchards; wherever there are infestations of plant lice. In the orchards of California they are very abundant and play an important part in the control of many bad pests, but more important in keeping down the aphids. When there is no prey in the orchards they go to the fields and brush to seek other game and return as soon as the lice begin to appear.

Internal Parasites.

Internal parasites are those which develop within the body of the host. The adult female, by means of a sharp ovipositor, deposits her eggs within the bodies of the lice. These eggs hatch, and the resulting young develop into legless, maggot-like individuals which live on the body juices of the aphids, thereby completely destroying them. When fully developed, a small hole cut in the backs of the lice liberates the adults, which immediately attack other living lice.

To these parasites, more than to all others, is due the credit of completely controlling many aphids which would otherwise become very destructive. They do not usually get in their work until rather late in the season, after the aphids have done most of their damage, but though late, it is sure. Though the natural enemies are very efficient in a majority of cases, yet all of the real pests (pests because they are not so held in check) must usually be controlled by artificial methods, of which spraying is recognized as the most efficient.

Artificial Methods of Control.

Sprays. Treatment for insects which are both aerial and subterranean in habits naturally calls for entirely different methods for each form. Of the species named above, two stand out as splendid examples of the subterranean form. They are woolly aphis and the black peach aphis, but both of these have aerial generations. The beet aphis (*Pemphigus betæ* Doane) and (*Trifidaphis radicicola* Essig) are not known to be other than strictly subterranean in their habits. In considering methods of control we shall take the woolly aphis (*Eriosoma lanigera* Hausm.) as an example.

Methods for Controlling Underground Forms.

Prevention. In setting out a young orchard one of the first things to consider is how to prevent the introduction of certain serious pests and diseases which may be carried on nursery stock. Both the peach aphis and the woolly aphis are easily distributed on young trees. The following precautions should be taken in setting out any new apple or peach orchard:

1. Set out clean stock. Do not buy trees which have the roots puddled unless the mud is washed off—it may hide the woolly aphis or black peach aphis and such infested trees would be severely handicapped and are not worth planting.
2. Woolly aphis does very little damage to the Northern Spy; especially is this true regarding the attacks on the roots, therefore, if possible, buy apple trees grafted on Northern Spy roots, if your section is troubled with the woolly aphis.
3. Set trees fairly deep, keep soil thoroughly cultivated so as to get roots down as far as possible. The woolly aphis seldom works lower than ten (10) inches below the surface.

Sprays. Before making applications around the crown of the tree for the controlling of root forms, first remove earth around the roots to a depth of six or seven inches and a distance of two or three feet from the crown. Use two or three gallons of liquid per tree, spraying thoroughly on exposed roots. When the liquid is nearly all soaked into the soil cover up the basin. The sprays which have given the most satisfaction in these cases are as follows:

Tobacco Leaves. A large number of tobacco leaves placed around the roots of the trees in the fall will do much to keep out underground lice.

Tobacco Decoction. Tobacco stems, dust or waste, 2 pounds; water, 3 gallons. Steep tobacco stems in water for at least one hour before applying. If whole leaf tobacco is used, 1 pound is sufficient for 3 gallons of water.

Black Leaf. Black leaf in proportions of 1 to 70 of water is also effective on the root forms.

Tanglefoot. If the dormant trees are sprayed with a strong solution of kerosene emulsion or lime-sulphur just before the buds open in the spring, it is well to put a tangle-foot band around the trunk of the tree to keep root forms from migrating to the top. In order to prevent injury to the tree the tangle-foot is smeared on heavy paper, which is placed around the tree in the form of a band with a thin layer of cotton beneath to keep any from crawling under.

Carbon Bisulfid. In light sandy or porous soils, carbon bisulfid is used very effectively. The treatment should be made early in the spring about April, as follows: Make 4 or 5 holes 8 inches deep from 18 inches to 2 feet from the tree. Into each pour from 3 to 4 liquid ounces of carbon bisulfid, and immediately cover the hole. See that the liquid does not come in contact with the roots.

Kerosene Emulsion. Kerosene emulsion is often used successfully on the roots, but is rather a severe treatment and should be avoided except by those experienced in its application.

Methods for Controlling Aerial Forms.

Winter Sprays for Dormant Trees. In order to destroy the eggs deposited by the sexual females in the fall, strong sprays should be applied in the winter when the trees are dormant, so as to prevent infestations for the coming year. The following sprays are recommended for this purpose:

Commercial lime sulphur, diluted 1 gallon to 6 gallons of water.
Kerosene emulsion.

Spring and Summer Sprays for Trees and Plants in Foliage.

Sprays for foliage cannot be as strong and severe as those used on dormant trees, and care must be taken to prevent serious burnings. In view of this, experience has proved the following sprays to be practical:

Kerosene emulsion.
Resin wash.
Soap and fish-oil wash.
Carbolic acid emulsion.

The above sprays should be used on hardy plants and particularly on orchard trees. While the following formula is specially recommended for tender plants, such as melon vines, vegetables, flowers, etc., it is equally good for fruit trees:

Soap and Tobacco Wash. Soap, 1½ pounds; tobacco decoction (as prepared on page 46), 1 quart; water, 5 gallons.

Dissolve the soap in five gallons of hot or boiling water; add the tobacco decoction; boil together five or ten minutes. If the mixture has boiled down, add enough water to make five gallons of spraying material.

This spray is specially recommended as a remedy for the melon aphis (*Aphis gossypii* Glover).

THE GRAPE PHYLLOXERA.

**Phylloxera vastatrix* Planchon.

(Fig. 38.)

General Appearance.—The presence of this pest is usually manifested by its work, which consists in the formation of rough wart-like galls upon the leaves and small knots upon the roots. The lice producing the galls are very small and orange-colored. White eggs and the young are also to be found within the galls, which are seldom found in California. The root lice are about one twenty-fifth of an inch long and greenish-yellow in summer and a little darker in winter.

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*According to priority rules the scientific name of this species should be *Peritymbia vitifoliæ* (Fitch).

Life History.—During the months of July and August some of the eggs laid by the females of the root forms hatch into individuals which acquire wings. These seek the foliage of the vines and lay large eggs which produce true females and small eggs which produce males. These mate and each female lays a single winter egg upon the bark of the two-year old wood. In the spring this egg hatches into a root form (or gall-making form) which gives rise to the root forms in other stages. These lay eggs which give rise to the many summer generations of devastating root insects. In California the latter hibernate in the soil and may continue for at least four years without reverting to the sexual forms.

Distribution.—While this pest has been supposed to be limited to the central portions of the State, its appearance in the north seems to indicate that it occurs to some degree in most grape-growing sections north of the Tehachapi.

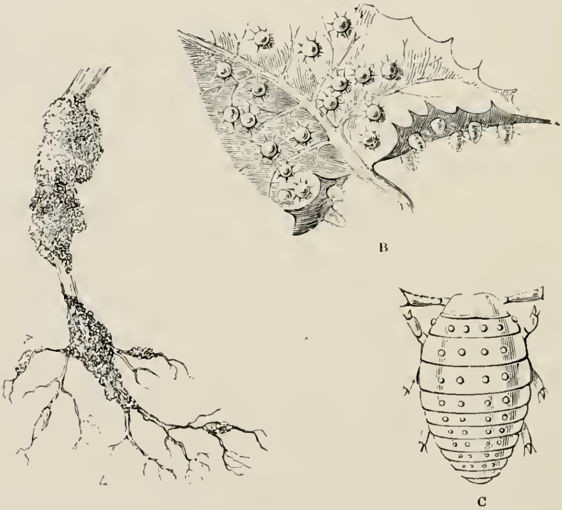

FIG. 38.—The grape phylloxera (*Phylloxera vastatrix* Planch.). A, infested grape root; B, galls on leaf; C, the root louse.

Food Plants.—This insect feeds upon practically all varieties of grape vines, but is most damaging to the European varieties. Many cultivated varieties and hybrids as well as wild species are slightly attacked, but not so as to greatly impair their growth. These latter are known as resistant vines and are important factors in the selection of roots for vines set out in Phylloxera-infested districts. While the leaves are damaged to some degree, the main source of injury is due to the attacks upon the young and vigorous roots which are completely destroyed. The roots of the so-called "resistant stock" do not materially suffer from such attacks.

Control.—By far the most important method of control is the use of resistant root stocks upon which are grafted the desired varieties. Of course care must be exercised in selecting stock for the various varieties and expert advice obtained before making extensive selections or plantings.

Direct remedies for infestations are unsatisfactory. Flooding the vineyards if the water can be held for a month will almost exterminate the pest, if done in the winter, but such a method is impracticable in most of the grape-growing sections of the State.

Carbon bisulfid is an efficient remedy in loose sandy soil, but in such places the pest is usually less abundant.

Natural Enemies.—In the eastern states many predaceous insects feed upon the gall form, but as this stage does not occur to any extent in California there are practically no results from these or other natural checks.

THE WOOLLY APPLE APHIS.

Eriosoma lanigera (Hausm.).

(*Schizoneura lanigera* Hausm.)

(Figs. 39, 40, 41.)

General Appearance.—To the average orchardists this insect is of too common occurrence to need any suggestions to recognize it. The dark red or purplish louse covered with the long white cottony wax or flocculence is the most serious apple pest in many of the northern counties. The winged forms are distinguishable by their dusky protruding wings. The fall and early winter lice are dark yellowish or brown in color.

Life History.—In the summer, especially during the months of July and August, the woolly aphis is exceedingly abundant upon the limbs of the trees, covering large patches with their extensive colonies. Towards winter they gradually disappear, only a few individuals remaining hidden under protecting bark or in crevices. In the fall the winged viviparous females give birth to true males and females which mate, each female laying a large egg which hatches into an over-wintering form. These have very little cottony covering and appear to be able to stand severe weather. The diminishing of the aerial forms usually accompanies the increasing of those working under ground upon the roots around the bases of the tree trunks. Here they may be found in great numbers during the winter and also during the early spring and even the summer months. These root lice prove as destructive to the tree and often more so than do those commonly observed above ground, but their work is often unknown to the orchardist.

In the spring the over-wintering lice give birth to young which mature in about ten days and which continue to repeat the process of bringing forth living lice until thousands appear upon the trees. How many of the aerial lice winter in the soil and how many of the root lice appear above ground in the spring is not known, but there are probably some which migrate in this manner.

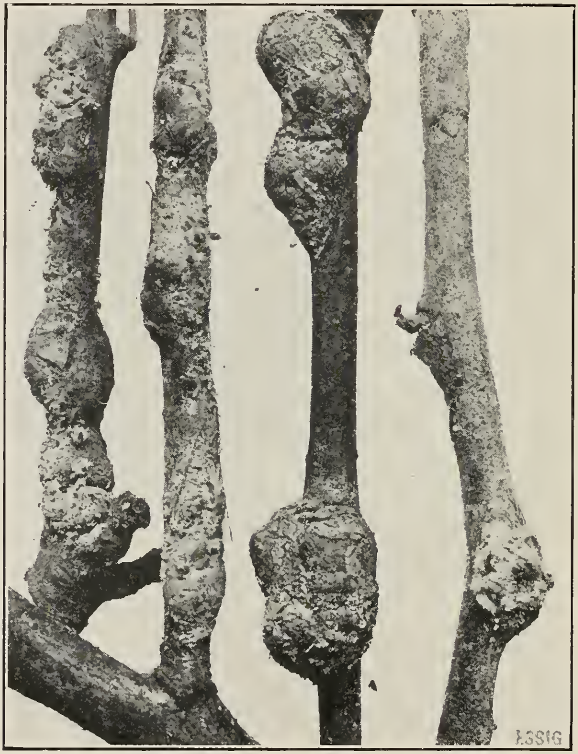

FIG. 39.—Apple twigs showing the work of the woolly aphis, *Eriosoma lanigera* (Hausm.). (Original.)

Distribution.—In practically every section where apples are grown in the State.

Food Plants.—The apple is the favorite food of this insect, though it does also feed upon the roots of the pear trees. The old limbs, young shoots, suckers and roots are attacked. Characteristic knots are produced upon the shoots and others somewhat different upon the roots, while upon the older limbs great rough enlargements appear and become nearly a foot in diameter and look considerably like a burl. In these many of the lice spend the winter.

There is considerable difference in the attacks upon varieties of the apple. The Northern Spy is practically immune and for this reason is much sought after as a resistant root stock for grafting purposes. Vigorous growing varieties such as the Rhode Island Greening and Bellflower are very much injured. In Humboldt County the former is decidedly undesirable because of the great injury from woolly aphis.

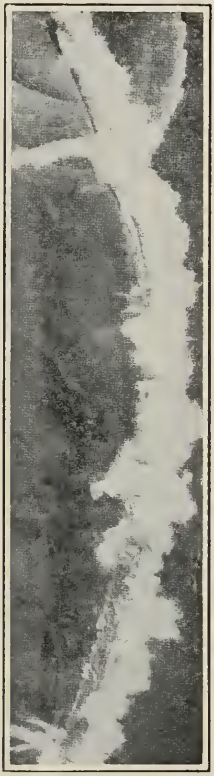

FIG. 40.—The woolly aphis, *Eriosoma lanigera* (Hausm.) on twig of apple. (After Hall.)

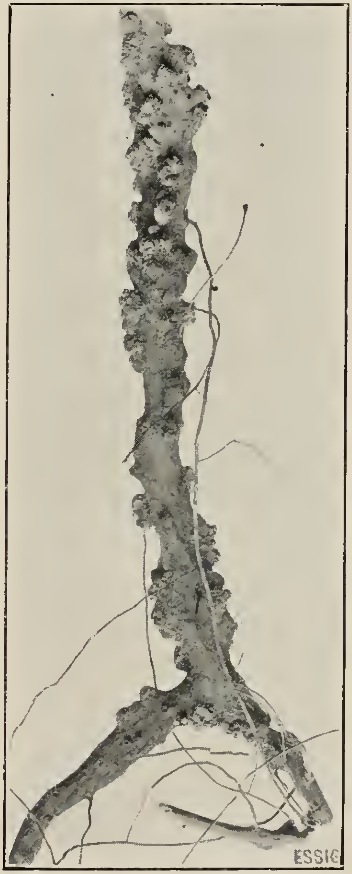

FIG. 41.—The work of the woolly aphis upon the roots of an apple nursery tree. (Original.)

Practically all other commercial varieties are affected in a more or less degree, the King of Tompkins County being injured the least in the north.

Control.—The control of the pest is given quite fully on pages 46 and 47. The important factors to be taken into consideration are to procure a spray that will dissolve the cottony covering; to maintain a pressure from 150 to 200 pounds; to apply a coarse driving spray and to do the work thoroughly, making as many repeated applications as necessary.

Natural Enemies.—While many of the natural enemies previously listed do much work upon this species they are no great factor in its control.

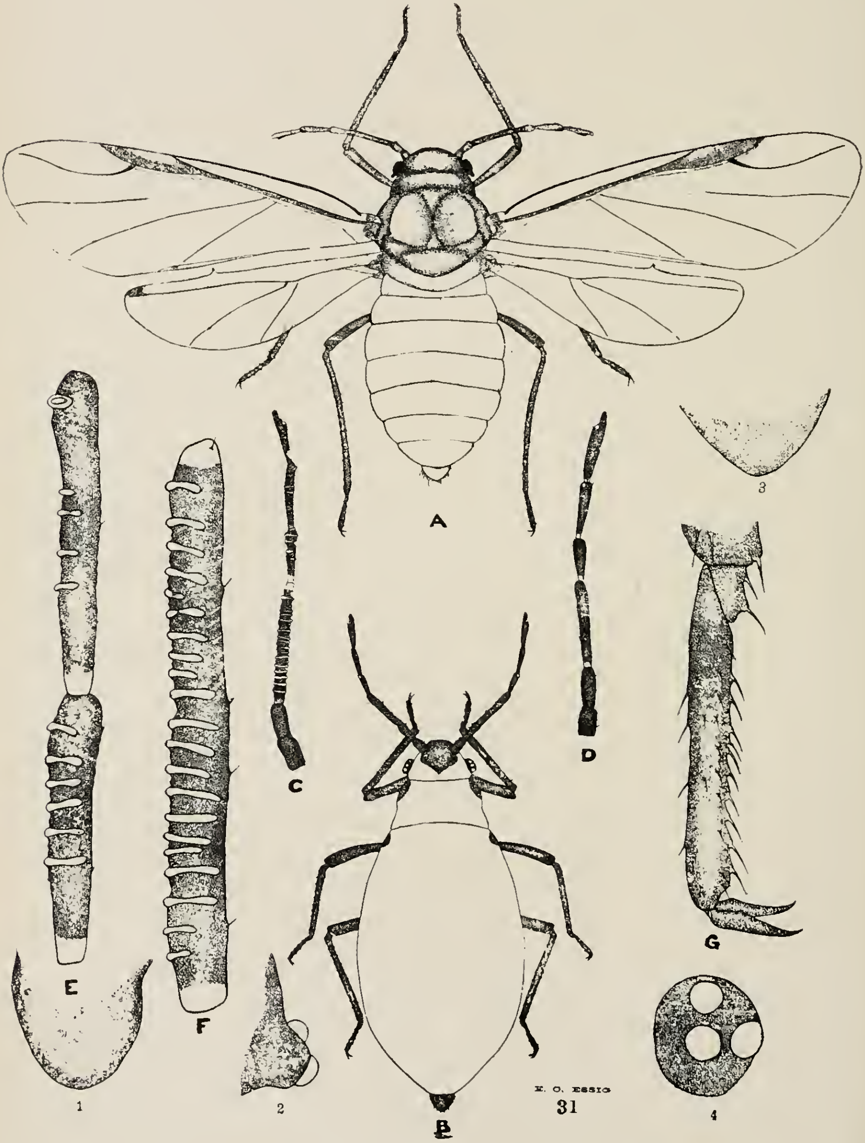

FIG. 42.—The woolly buttercup louse (*Pemphigus californicus* Davidson). A, winged female; B, apterous female; C, antenna of winged female; E, fourth and fifth and F, third antennal articles of winged female; D, antenna of apterous female; G, tarsi; 1, style; 2, lateral and 3, front view of lateral tubercle of compound eye. (Essig, P. C. Jr. Ent.)

THE WOOLLY BUTTERCUP LOUSE.

Pemphigus californicus Davidson.

(Fig. 42.)

General Appearance.—Light green or yellow, covered with long white flocculence. The winged forms have dark head and thorax. Quite a large form being 3.3 mm. in length.

Life History.—Appears early in April on the lower leaves and at the bases of the stems of the common buttercup. Both apterous and winged forms are abundant. Completely disappears in the fall. It must have some alternate host which is still unknown.

Distribution.—Throughout the central and southern part of the State. Collected by Wm. Davidson at Palo Alto in Santa Clara County, and by the writer at Nordhoff in Ventura County.

Food Plant.—The common California buttercup (*Ranunculus californicus*).

THE BEET LOUSE.

Pemphigus betæ Doane.

General Appearance.—The adult wingless lice are about one eighth of an inch long; somewhat rounded or elongated in shape; whitish or pale yellow in color with a large tuft of white flocculence covering the posterior end of the body. The legs, antennæ, and spots on the top of the head are brown. The winged lice are a little larger, more elongated and much darker in color. The head, antennæ, legs and thorax are black and being usually covered with a fine, white powder appear bluish-black; abdomen dark green. The presence of this pest is easily told by the white flocculence which covers the lice as well as surrounding infested areas on the roots.

Distribution.—Appears to be distributed only in the sugar beet growing sections of the central and southern parts of the State.

Food Plants.—As this is a subterranean aphid, only the roots are affected, but often in such a way as to ruin portions of the crop. Sugar beets are the only economic plants attacked to any injurious degree. Wild yarrow, dock, knotweed (*Polygonum aviculare*) are also attacked.

THE POPLAR-STEM GALL-LOUSE.

Pemphigus populicaulis Fitch.

(Figs. 43, 44.)

General Appearance.—Stem mother is slightly green or yellow, covered with distinct rows of small cottony patches, one eighth to one fourth of an inch long, and nearly as wide. Winged females are much smaller, dark in color and covered with fine wax and long white flocculence.

Life History.—The stem mother starts the peculiar gall on the stem at the base of the leaf, and produces young until the large gall is completely filled. So tightly closed is the entrance of the gall that few, if any, parasites get in. When the inhabitants are ready to migrate in the late summer a distinct opening is made, through which they escape in great numbers.

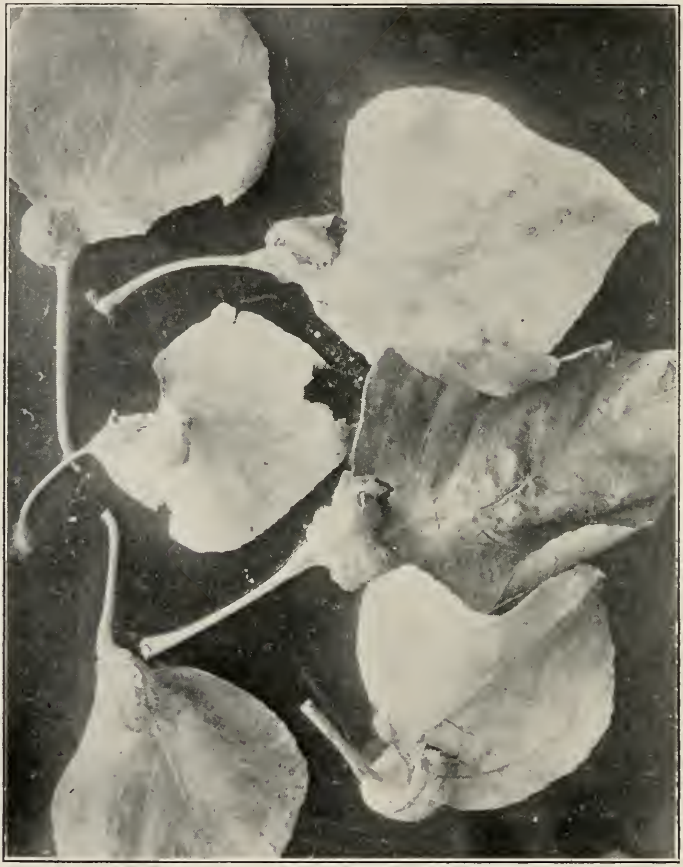

FIG. 43.—Galls on cottonwood leaves produced by the poplar-stem gall-louse (*Pemphigus populicaulis* Fitch). (Essig, P. C. Jr. Ent.)

Distribution.—Throughout the State, wherever the host plants are found.

Food Plants.—Common cottonwood (*Populus trichocarpa*), *P. monilifera* and *P. tremuloides.*

Natural Enemies.—Preyed upon by internal parasites in late summer, but more often the food of a small bug belonging to the family *Acanthiidæ.*

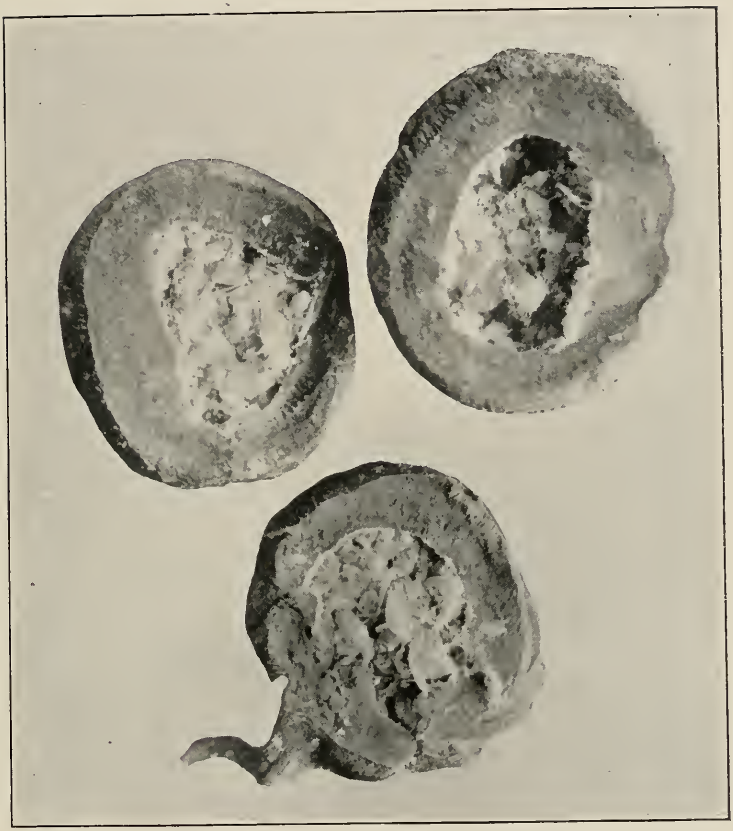

Fig. 44.—Cross-section of galls, showing all stages of the lice inside. (Essig, P. C. Jr. Ent.)

THE BEAD-LIKE COTTONWOOD GALL-LOUSE.

Pemphigus populimonilis Riley.

(Figs. 45, 46.)

General Appearance.—The body is dark and covered with rather long white flocculence, which gives it a bluish appearance. The presence of the lice is easily told by the very characteristic reddish, bead-like galls formed on the margins and centers of the leaves of the cottonwood trees which they infest.

Life History.—The female louse or stem mother either deposits the eggs or brings forth offspring which give rise to the spring generations. There is usually but one winged female to be found in each gall, but often there are also present several larvæ of a syrphid fly, which feed upon the lone occupant. For this reason many of the galls will be found empty during the later summer months. However, in

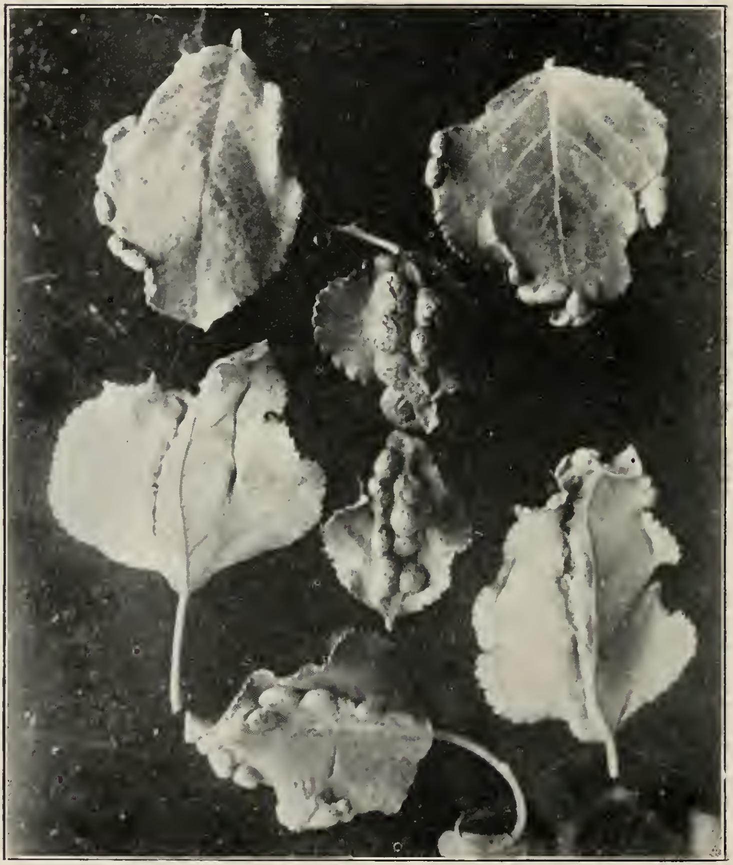

FIG. 45.—The bead-like galls on cottonwood leaves produced by the gall-louse (*Pemphigus populimonilis* Riley). (Essig, P. C. Jr. Ent.)

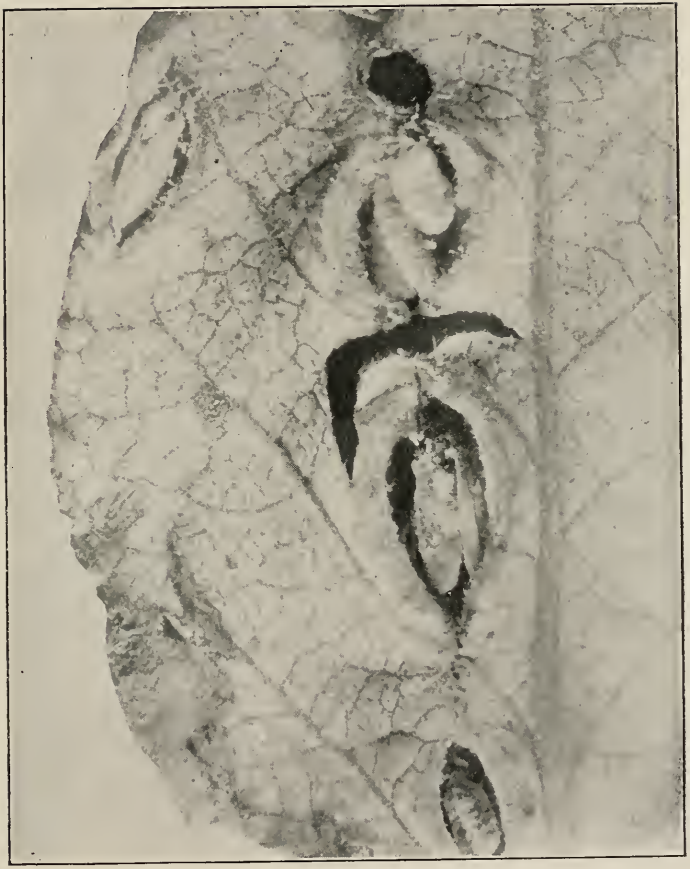

FIG. 46.—The under side of a cottonwood leaf showing the opened galls of *Pemphigus populimonilis* Riley. The various stages of the lice and also a syrphid larva are visible. (Essig, P. C. Jr. Ent.)

the fall all of the adult forms leave the galls and either hibernate in the adult or egg form. The life history has not been fully worked out.

Distribution.—Throughout the State, wherever the host plants grow.

Food Plants.—The common cottonwood (*Populus trichocarpa*), *Populus fremontii, P. balsamifera* var. *angustifolia*.

SOLANUM ROOT LOUSE.

Trifidaphis radicicola (Essig).

General Appearance.—The apterous females are distinctly globular in shape and vary from amber to cream-color and often with a fine, white, powdery covering. The winged forms are amber with head and thorax dark. The wings are also dusky. Length, 1 to 2 mm.

Life History.—The lice are subterranean in their habits and are evident during the early spring and the entire summer. The winged forms appear in July and August. It has not been determined whether eggs are deposited or not, but so far the writer has been unable to find any.

Distribution.—Throughout the central and southern parts of the State; especially abundant in the south.

Food Plants.—Roots of *Solanum douglasii, Amaranthus retroflexus* and potato tubers.

MONTEREY PINE LOUSE.

*Essigella californica** (Essig).

(Fig. 47.)

General Appearance.—Very slender; light green; covered with minute red dots; slightly pruinose; and with noticeably long hind legs. Length 1.6 to 2 mm.

Life History.—So far as known all stages are passed on the pine trees where they are not abundant until the summer, although specimens were taken in the winter. Two forms, apterous and winged females, are present.

Distribution.—Throughout the State.

Food Plant.—Monterey pine (*Pinus radiata*). The insect works on the needles around which it clasps its long hind legs for support.

Natural Enemies.—Internal parasites and predators hold this species in check so that it does little or no damage.

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*The specific name has been changed to agree with the new generic name.

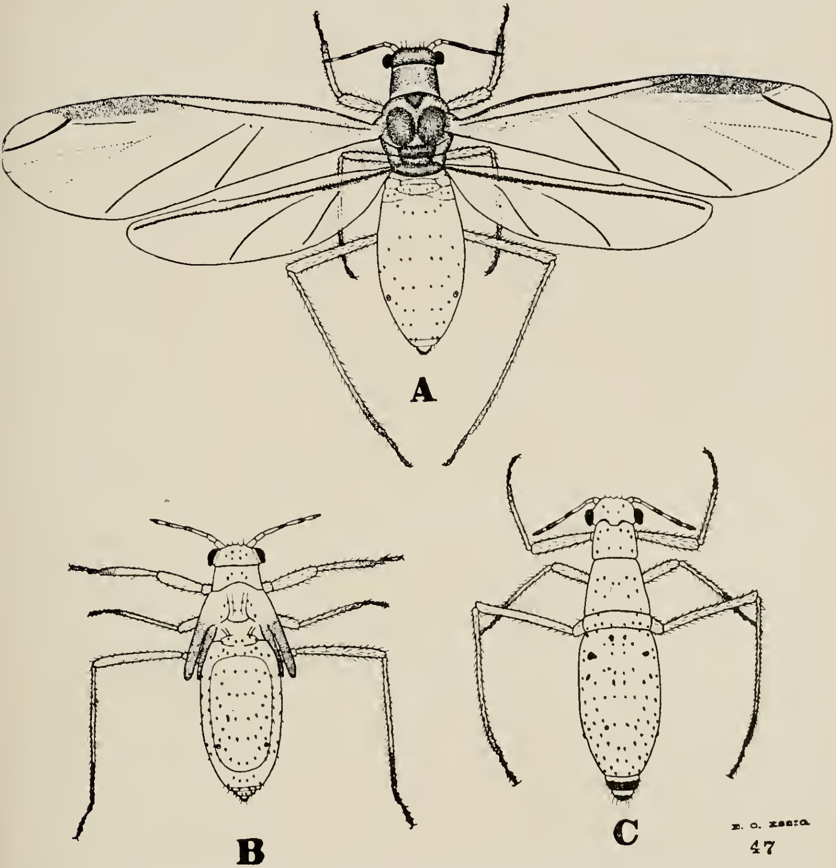


Fig. 47.—The Monterey pine louse, *Essigella californica* (Essig). A, winged female; B, nymph of the winged female; C, apterous female. (Essig, P. C. Jr. Ent.)

THE CABBAGE LOUSE.

Aphis brassicæ Linn.

(Fig. 48.)

General Appearance.—Dark greenish yellow to brownish, with dark transverse bands across the abdomens of some individuals. All covered with a fine white powder, which gives them a silvery or frosted appearance.

Life History.—The lice appear with the first plants in the spring and increase with such rapidity as to soon almost entirely cover the host. This condition prevails throughout the early summer, after which the parasites begin to reduce their numbers. It is a disgusting pest on cabbage, cauliflower and brussels sprouts.

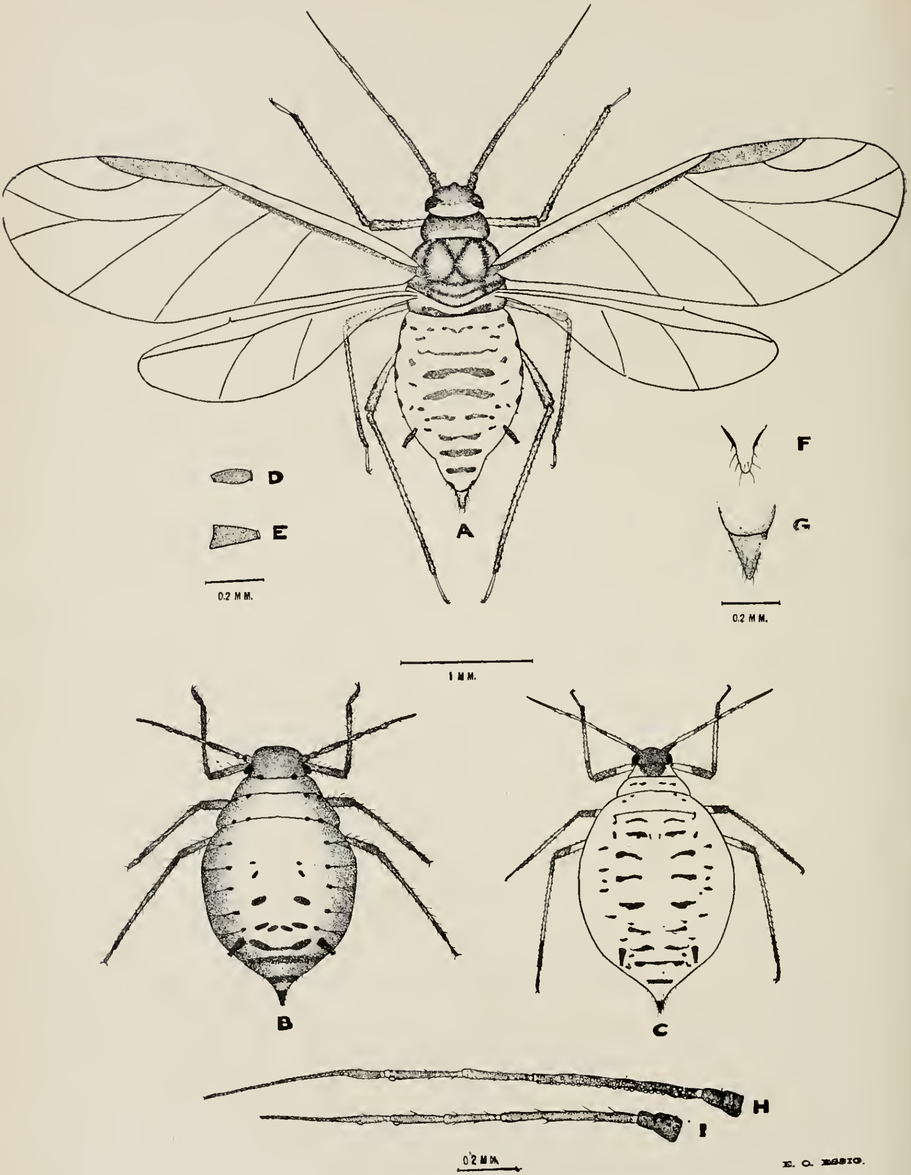


Fig. 48.—The cabbage louse (*Aphis brassicæ* Linn.). A, winged female; B and C, apterous females; D, F and H, cornicle, style and antenna of winged female; E, G and I, same of apterous female. (Essig, P. C. Jr. Ent.)

Distribution.—Throughout the entire State.

Food Plants.—All members of the *Cruciferæ* including cabbage, cauliflower, brussels sprouts, mustard, radish, etc.

Natural Enemies.—The ladybird beetles, *Hippodamia convergens, Megilla maculata* and *Coccinella californica*, prey to some extent upon this pest. The real check, however, is the internal parasite, *Diæretus californicus* Baker.

WOOLLY CITRUS APHID.

Aphis cookii Essig.

(Fig. 49.)

General Appearance.—The bodies vary from light gray to very dark brown or almost black, and are covered with short or rather long white cottony wax, which is arranged in transverse rows across the abdomen. This covering often almost completely hides the insects.

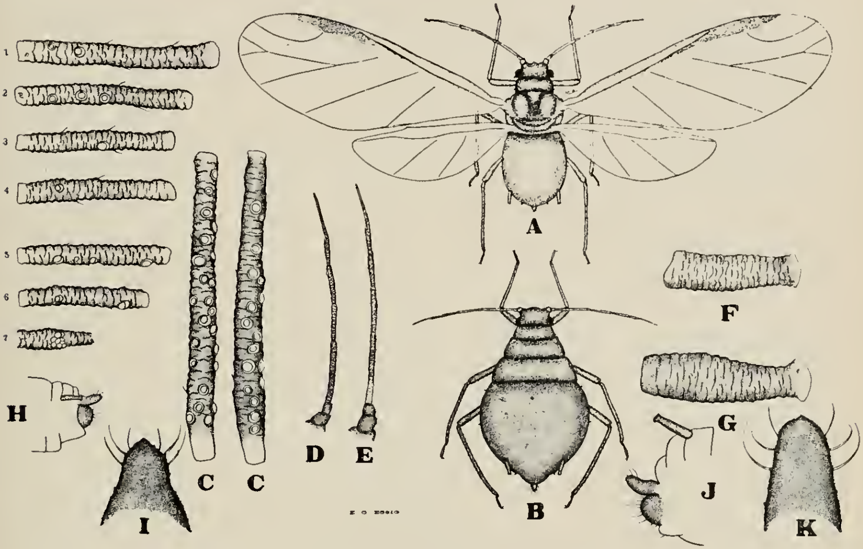


Fig. 49.—The woolly citrus aphid (*Aphis cookii* Essig). A and B, adult forms; C, third antennal articles; D and E, antennæ of winged and apterous females; F and G, cornicles of winged apterous females; H and I, pygidium and style of winged female; J and K, pygidium and style of apterous female; 1-4, fourth antennal articles; 5-6, fifth antennal articles; 7, process of sixth antennal article. (Essig, P. C. Jr. Ent.)

Life History.—Is not well known. The insect was first discovered by C. H. Vary at Pomona, California, in April, 1910. He brought specimens to the writer, stating that the original infestation was destroyed. Attempts to find other specimens proved futile. Whether the insect was introduced or came from native shrubbery is unknown.

Distribution.—Only one locality, near Pomona, California.

Food Plants.—Navel orange trees.

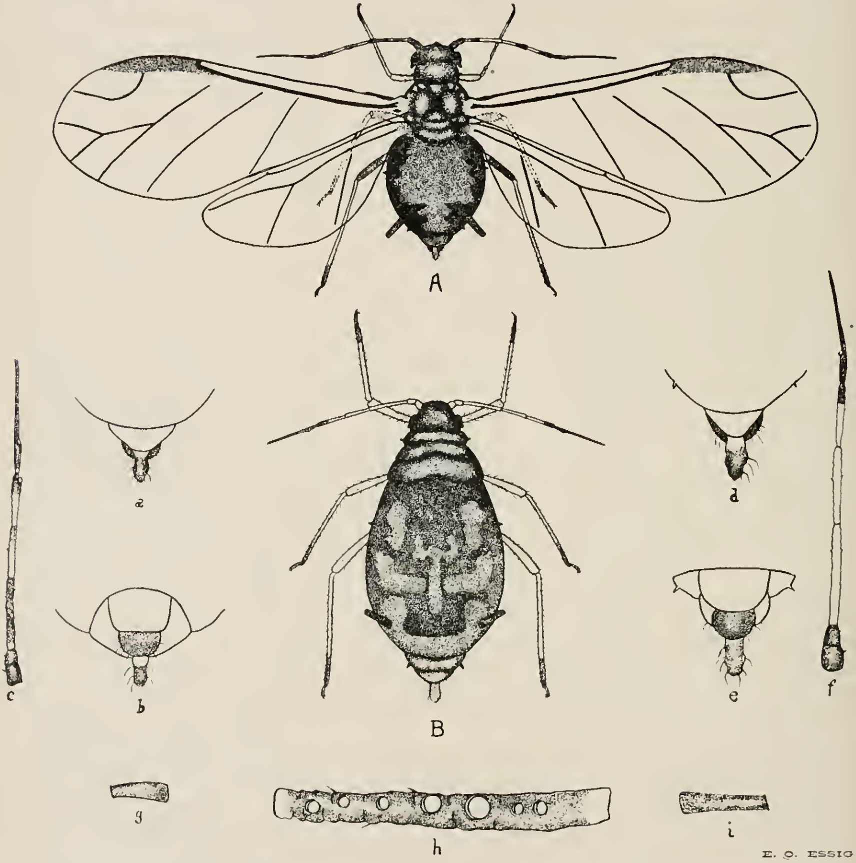
THE MELON APHIS.

Aphis gossypii Glover.

(Fig. 50.)

General Appearance.—The lice are small and very dark in color, varying from dark green or brown to black. The apterous female is usually dark green with often irregular lighter markings on the abdomen. The nymphs are usually somewhat lighter than the apterous females.

Life History.—The lice appear early in the spring, infesting all sorts of plants and often becoming a most serious pest before the farmer is aware of their presence. They continue to work until about the middle of the summer, when they gradually decrease and are apparently all gone by winter.



E. O. ESSIG.

FIG. 50.—The melon aphis (*Aphis gossypii* Glover). A, winged female; B, apterous female; a and b, dorsal and ventral aspects of pygidium of winged female; c, antenna, g, cornicle, h, third antennal article of same; d and e, pygidium of apterous female; f, style and i, cornicle of same. (Essig, P. C. Jr. Ent.)

Distribution.—Throughout the entire State. Without doubt this is one of the commonest black aphids met with.

Food Plants.—The foliage and young shoots of the plants are attacked. On citrus trees the tender shoots are often entirely destroyed by the lice. Vines are injured throughout. The plants attacked by this pest are: all citrus species, shepherd's purse (*Bursa bursa-pastoris*), melons, gourds and cotton.

Natural Enemies.—The ladybird beetles, *Hippodamia convergens* Guer. and *Hippodamia ambigua* Lec.; the internal parasites, *Aphidius testaceipes* (Cresson) and *Charips xanthopsis* (Ashm.) and the larvæ of the green lacewing (*Chrysopa californica* Coq.) all prey upon this louse.

THE ENGLISH IVY PLANT LOUSE.

Aphis hederæ Kalt.

(Fig. 51.)

General Appearance.—The apterous females are usually abundant on tender shoots of the English ivy, and vary from brownish to black, often with a pruinose coat which gives them a gray appearance. The winged forms are very dark.

Life History.—The apterous forms begin to appear in early spring and continue to breed until late summer, when the work of internal parasites becomes such as to almost exterminate the pest. Winged forms also occur until late summer. The louse does some damage early in the summer, but is not a serious pest.

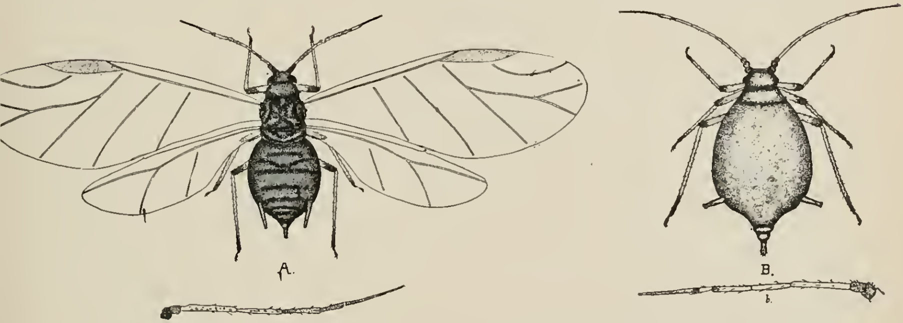


FIG. 51.—The ivy louse (*Aphis hederæ* Kalt.). A, adult winged female and antenna; B, adult apterous female and antenna. (Essig, P. C. Jr. Ent.)

Distribution.—Throughout the entire State, but more abundant in the southern part.

Host Plant.—English ivy.

Natural Enemies.—Held in complete check by a small internal parasite. The mummied bodies appearing in the fall show the efficient work of this natural check.

THE CORN LEAF-APHIS.

Aphis maidis Fitch.

(Fig. 52.)

General Appearance.—The adult aphids are bluish-green in color. Young lice vary from a reddish brown to the color of the adults.

Life History.—The life history of this louse is very imperfectly known, several stages being entirely unobserved. In the early summer the lice appear in great numbers upon the young ears, leaves and tassels of the corn stalks and continue to breed and feed there until the foliage begins to dry and the corn to ripen. Where they go, upon what they feed afterwards and how they pass the winter are unknown. Due to the fact that this louse does little direct injury, no extended study has been made.

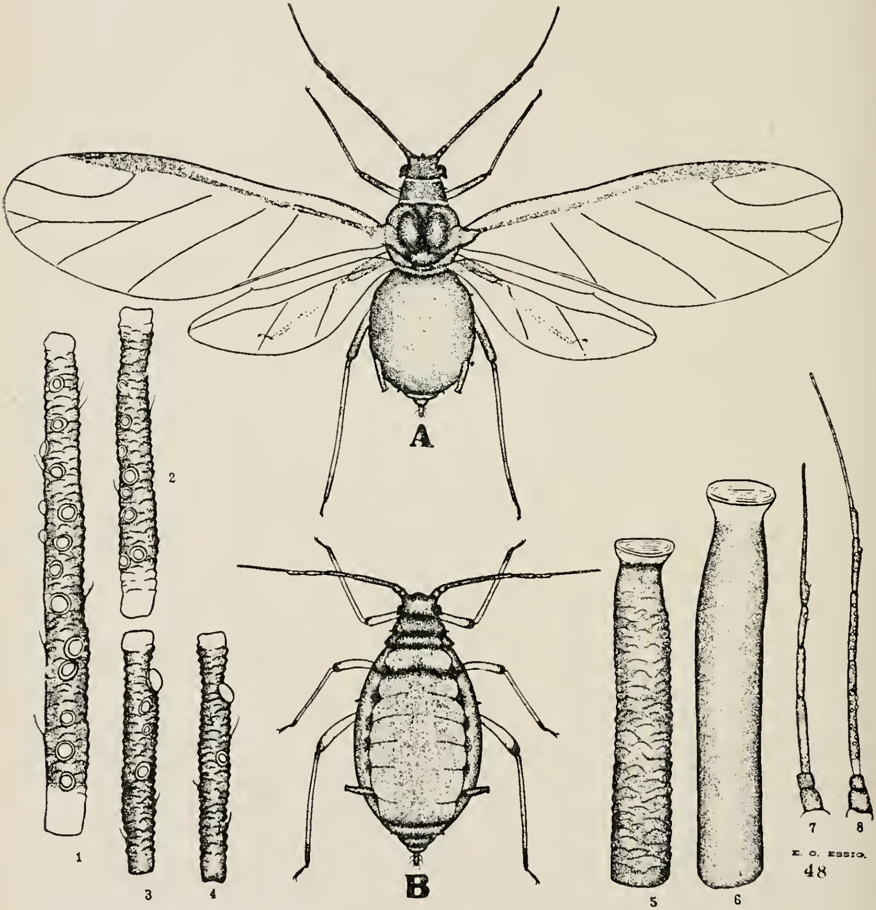


FIG. 52.—The corn leaf-aphis (*Aphis maidis* Fitch). A and B, adult lice; 1, third antennal article of winged louse; 2 and 3, fourth antennal articles of winged louse; 5 and 6, cornicles of winged and apterous females; 7 and 8, antennæ of apterous and winged lice. (Essig, P. C. Jr. Ent.)

Distribution.—This aphid is well distributed throughout the entire State and may be found in almost every growing cornfield.

Food Plants.—The known food plants of this louse are corn, sorghum and occasionally barley.

Natural Enemies.—While practically all of the enemies enumerated in the beginning of the article on plant lice work upon this louse, the writer found it to be specially heavily parasitized by an internal parasite. The larvæ of the small syrphid fly, *Allograpta obliqua,* were also responsible for destroying great numbers of lice. These natural enemies must certainly be responsible for keeping the corn leaf-aphis from becoming a pest.

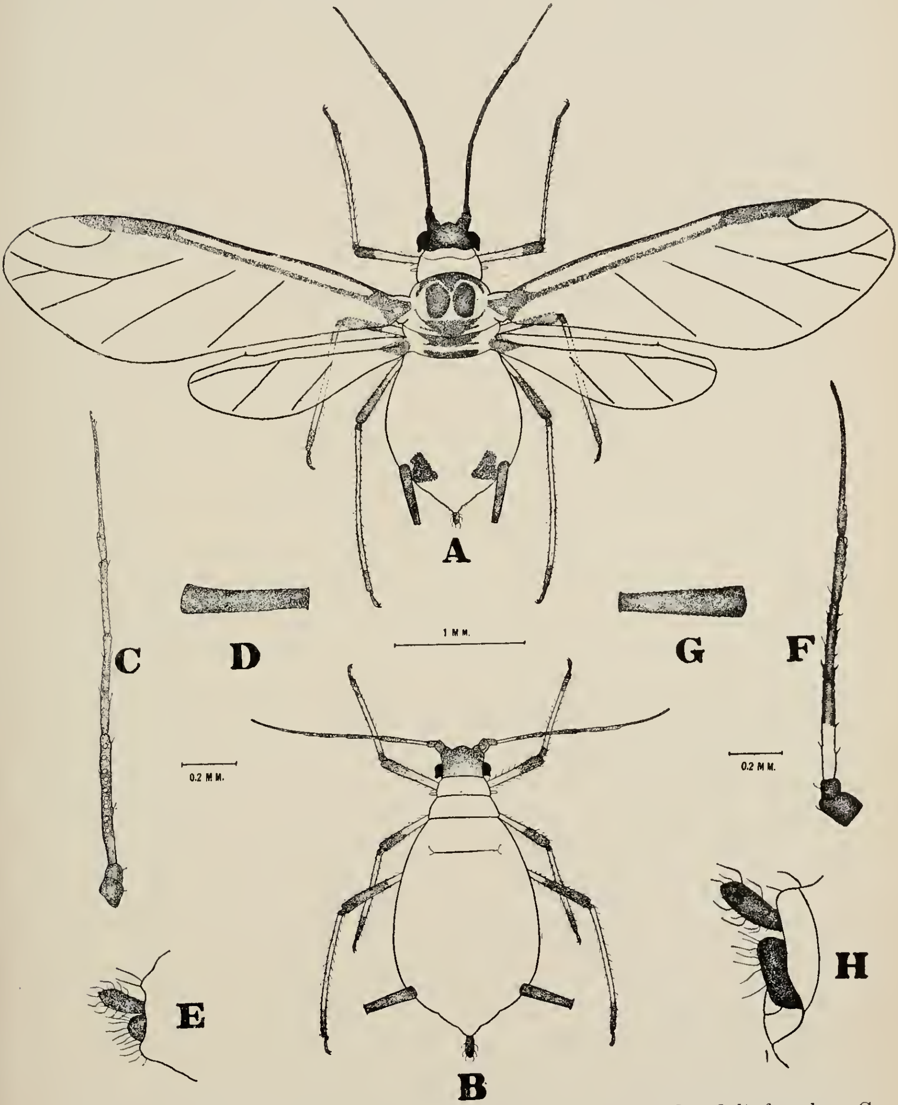


FIG. 53.—The oleander aphid (*Aphis nerii* Fonsc.). A and B, adult females; C, D and E, antenna, cornicle and lateral aspect of pygidium of winged female; F, G and H, same for apterous female. (Essig, P. C. Jr. Ent.)

THE OLEANDER APHID.

Aphis nerii Fonsc.

(Fig. 53.)

General Appearance.—Deep yellow apterous forms with dark antennæ, cornicles, dusky head and tips of leg joints. The winged form has dark head, black spots on the thorax and a black blotch at the base of each cornicle, as well as dark antennæ, cornicles and tips of leg joints.

Life History.—Young appear in the early spring on the young shoots and buds of the oleanders. Great colonies are soon produced, which continue throughout the early summer, when the natural enemies begin to appear. Winged and apterous forms may be found in nearly equal numbers.

Distribution.—Throughout the entire State.

Food Plant.—Oleander, works on the buds and terminals of the young shoots.

Natural Enemies.—The common ladybird beetles prey upon this species to some extent, but the internal parasites, *Aphidius testaceipes* and *Charips xanthopsis*, aid in holding it in check. Syrphid flies, especially *Syrphus americanus*, also prey upon it.

THE BLACK PEACH APHIS.

Aphis persicæ-niger Smith.

(Fig. 54.)

General Appearance.—The full-grown winged and apterous forms are of average size, robust and shiny black in color. The young are reddish yellow or brownish and are always more abundant than the shiny black adults. The characteristic shape as shown in Fig. 54 and the color make the determination of the species quick and certain. Like the woolly aphis, this insect has a root and ærial form and is responsible for much damage.

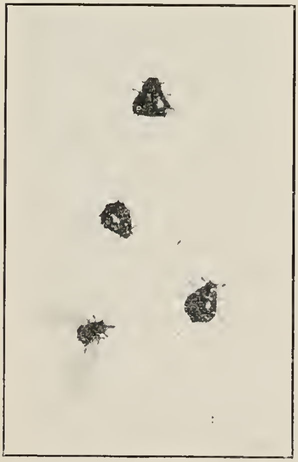


Fig. 54.—Adults of the black peach aphis, *Aphis persicæ-niger* Smith. (Original.)

Life History.—The insect winters over on the roots of peach trees, where it may also be found in the summer. The first lice appear above ground very early in the spring and begin attacking the tender leafless shoots or suckers—usually those at the base of the tree or nearest the ground. These lice are all wingless. As soon as the buds, young fruit and leaves appear they are promptly attacked, often the entire crop being almost completely ruined. The leaves are curled and weakened while the young fruit is so distorted as to be killed or rendered unfit for market. During the months of April and May, winged migratory females appear, which start colonies upon other trees. The work continues until about the middle of July, when most of the lice leave the tops and again go to the roots.

Distribution.—This louse is at the present time found in nearly every peach growing county in the State and may be expected to appear in practically any such locality.

Food Plants.—So far as known this louse attacks only peach, plum and nectarine trees, working above ground upon the leaves, twigs and fruit and below ground upon the roots.

Control.—The control of this louse has caused considerable anxiety in some sections of the State, while in others it is feared no more than the green peach aphid (*Myzus persicæ*). The treatment is the same as for the ordinary ærial and root forms.

Natural Enemies.—Natural enemies play an important part in its control. In Tehama County the larvæ of the syrphid fly (*Syrphus americanus*) were present in great numbers feeding upon the aphids.

THE GREEN APPLE APHIS.

Aphis pomi DeGeer.

(*Aphis mali* Fab.)

(Figs. 55, 56.)

In order that the readers may get a true idea of the development and habits of plant lice the full life history of this species is given as an example:

Eggs.—We shall first begin with the small black shiny eggs which are found in great numbers on the smooth bark of the rapidly growing twigs or water sprouts of the apple tree. When these eggs were first deposited, some time during the months of October, November, or as late as December, they were of a beautiful green color, but with age turned to a shiny metallic black. A careful examination in winter of the young twigs and water sprouts of an orchard which was infested with this insect in summer will often show great numbers of these eggs—in some cases completely covering the twigs.

The eggs themselves are very tiny, not nearly as large as a pinhead, and are long and oval in shape. Only a small percentage of them hatch, and this accounts for the large number necessary to produce so many lice for the coming spring. In the eastern states, where the winters are very severe, it is estimated that only one per cent hatch. In California, however, a much larger percentage is able to withstand our milder climate, and so the succeeding infestations are even more severe here than they are in colder climates. Since such a small percentage hatch you may marvel at the rapidity in which this insect multiplies, but this will be brought out in a further study of the life history.

Just before the apple buds show green the eggs begin to hatch. This, of course, depends entirely upon the weather, and an early spring will bring a much more rapid development than will a cold, late spring.

Stem Mothers.—The young which hatch from the eggs in the early spring give rise to all succeeding generations, and are known as "stem mothers" when fully developed. The first young are darker green than any of the succeeding broods. In seeking food they work into the newly opening buds and on the first tender leaves. Due to their small size they can scarcely be noticed except by very careful observation. They seek the young buds for two reasons: first, because the tender leaves furnish the first food; second, because hid down in the folds of the buds they are free from the attacks of natural enemies, and incidentally out of reach of sprays. In warm weather the young will develop in two or three weeks and become adult stem mothers. These stem mothers still appear dark green and have a distinct, dark head, feet, tail and honey tubes. They do not have wings, a characteristic of this brood.

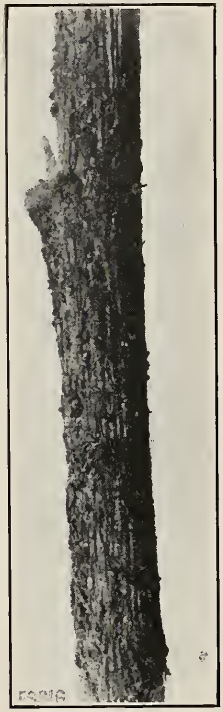


Fig. 55.—Eggs of the green apple aphis (*Aphis pomi* DeGeer) on young apple twig. (Original.)

Second Generation.—Every stem mother when full grown has the power (which we call parthenogenesis) to give birth to living young without intercourse with a male, for no males appear at all until late in the fall. The young thus born alive constitute the second generation. They are light green in color, are all parthenogenetic females, and though most of them are wingless, a very few winged individuals appear, but these like the apterous forms are females.

Third Generation.—The new broods of the second generation develop in a few weeks and in turn give birth to living young like themselves, but this generation is accompanied by a large number of winged females. The apterous and winged females of the succeeding generations are those most usually observed in the orchards and cause the greatest amount of damage. A brief descriptions of each is as follows:

Wingless Female.—This form is somewhat larger than the original stem mother, and is lighter green in color, with a yellowish tinge. The cornicles (honey tubes), tail, part of the antennæ and the extreme tips of the feet are dark. This form has the power to give birth to both living wingless and winged lice.

Winged Female.—These are recognized at once by their wings, which are usually folded roof-like over the back. The general color is black and green (the head, thorax, cornicles and portions of the legs and antennæ being black and the remainder green). Like the apterous forms they have power to produce both winged and wingless forms.

The appearance of the winged individual is very significant in that this migratory form is the principal means of distribution and of the formation of new summer colonies. Many plant lice winter over on fruit trees as does the hop louse, and the winged forms later migrate to the hop fields and produce the broods which so trouble the hop growers. Late in the fall the winged forms migrate back from the hop fields to the plum and produce the egg-laying females which deposit their eggs on the trees. The eggs give rise to the next year's broods.

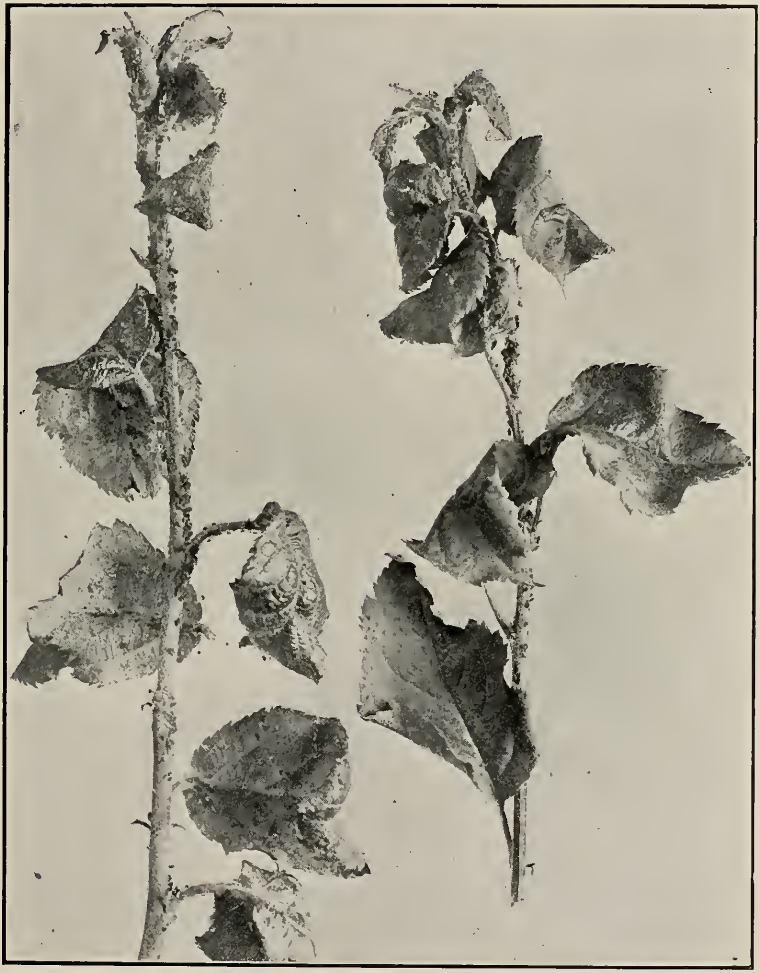


FIG. 56.—The green apple aphis (*Aphis pomi* DeGeer) infesting young apple shoots. (After U. S. Dept. Agrcl.)

Throughout the entire summer months broods upon broods, each in turn producing other broods, give rise to millions of this destructive pest, and this accounts for their great and infinite numbers. It has been estimated that a single stem mother will give rise to one billion insects during a single season. With the coming of cold weather, and after the first frost, there is a rapid diminution in numbers, and soon practically all of the winged individuals disappear. This is brought about, especially in the case of the apple aphis, by the development of true sexual forms, male and female.

Sexual Forms.—The parthenogenetic females of the late fall, instead of producing individuals of their own kind, give birth to true sexual forms, male and female, both of which are apterous.

Sexual Female.—The egg-laying female is much smaller than the summer form, and varies from a rich green to a brownish or reddish color. The head, cornicles, feet and tips of antennæ are dark.

Sexual Male.—The males are very small, hardly half as large as the other lice. They are easily recognized by their frail and slender bodies, long legs and light yellowish color. The head and tail are noticeably dark. They are much more active than are the sexual females, with which they associate and may be confused. These sex forms copulate and the female produces the eggs which give rise to the first stem mother already referred to. While the life history of this insect is typical in the number of generations, there are no root forms, as in the cases of the woolly aphis and black peach aphis; neither do winged sexual forms appear as in the case of some other species.

Distribution.—Common throughout the entire State. A serious pest in the central and northern parts.

Food Plants.—The host plants of the apple aphis are not many. It is found on the apple, pear, hawthorn, quince and flowering crab. Of the apples, those which appear to be the favorites are the Missouri Pippin, Rome Beauty, Black Twig, Ben Davis, Greening, though it works just as effectively on many other varieties. The Northern Spy is fairly free from its attack.

THE ROSY OR PURPLE APPLE APHIS.

Aphis sorbi Kalt.

(*Aphis pyri* Boyer.)

(*Aphis malifoliæ* Fitch.)

General Appearance.—This insect gets its common name from its rosy or purplish color, which readily distinguishes it from the green apple aphis. The head and thorax of the winged forms are dark. The bodies of all are slightly covered with white powder which often gives a grayish cast.

Life History.—The life history of this species is very imperfectly known. The eggs laid upon the trees the previous fall hatch in the spring about blossoming time and the young lice at once begin to attack the young leaves and fruit. The work upon the leaves is similar to that of the green apple aphis, causing them to curl and turn yellow. The work upon the fruit is even more destructive, causing deformity and non-maturity. In most of the apple growing sections of the State the attacks of this louse have been exceedingly severe. About June the species leaves the fruit trees and migrates to unknown host plants and does not return until fall in time to give birth to the true sexual forms, which produce the over-wintering eggs. As in the case of green apple aphis many successive and overlapping broods occur each year.

Distribution.—Widely distributed in practically every apple growing section of the State.

Food Plants.—Especially attacks the foliage and young fruit of the apple, but also works upon the hawthorn and *Sorbus* sps.

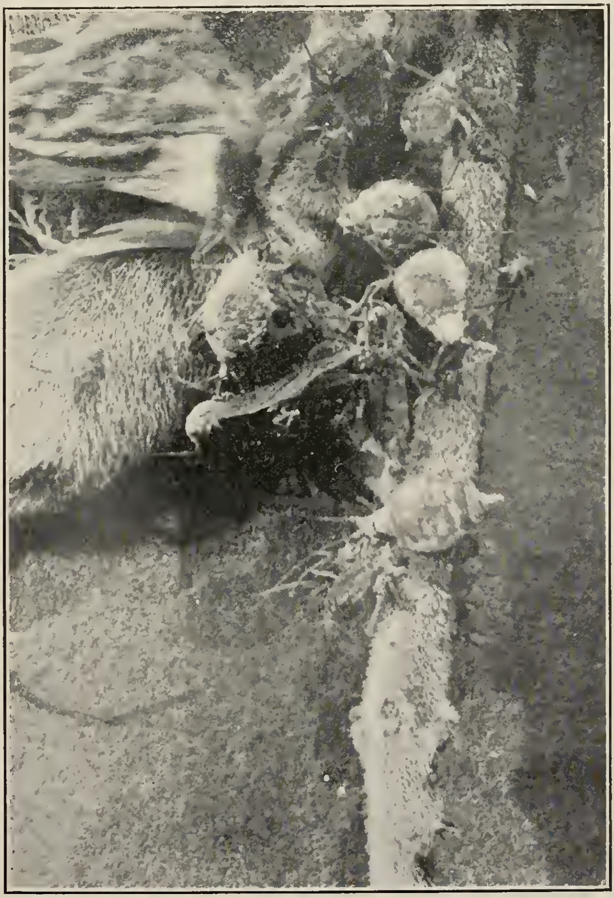


Fig. 57.—The lupine aphid (*Macrosiphum albifrons* Essig) on wild lupine. (Essig, P. C. Jr. Ent.)

THE LUPINE APHID.

Macrosiphum albifrons Essig.

(Fig. 57.)

General Appearance.—Large green lice, completely covered with fine white powder, which makes them appear silvery-gray; length, 3 to 4 mm.

Life History.—The lice appear in the spring, soon after the lupines are well started, and are especially abundant about flowering time. The younger shoots and especially the flowering tips are attacked and many lice continue to work upon the green seed-pods. The species collects in large colonies and works great havoc upon the hosts.

Distribution.—In the southern part of the State.

Food Plants.—Wild lupine (*Lupinus albifrons*). The insect is mentioned here because of its liability to infest lupines used for cover crops.

Natural Enemies.—The writer was able to breed out a large internal parasite from this species, which has not been determined.

THE GREEN CITRUS LOUSE.

Macrosiphum citrifolii (Ashm.).

(Fig. 58.)

General Appearance.—A large green louse, about the size of and greatly resembling the destructive pea louse (*Macrosiphum destructor*) in color and shape. Under the microscope it will be found that the tips of the cornicles (honey tubes) of the pea louse are perfectly plain, while there are mosaic markings on those of the green citrus louse.

Life History.—The young lice appear on the tender shoots early in April and are especially abundant upon young orange trees in the nursery. Winged and apterous forms continue to appear throughout the entire summer, but only in the spring and early summer is this species a pest.

Distribution.—Throughout the citrus belt of Southern California.

Food Plants.—Found especially abundant upon young orange seedlings and on suckers of large seedling orange trees. It is probable that the older foliage of most of the orange trees is attacked.

Natural Enemies.—The larvæ of the predaceous ladybird beetle (*Hippodamia convergens*) feed upon this species in limited numbers. The most efficient predators are the larvæ of the green lacewing (*Chrysopa californica*) and the large syrphid fly (*Lasiophthicus pyrastri*). The internal parasite *Charips xanthopsis* also works upon this pest. These natural enemies are usually sufficient to hold it in perfect control.

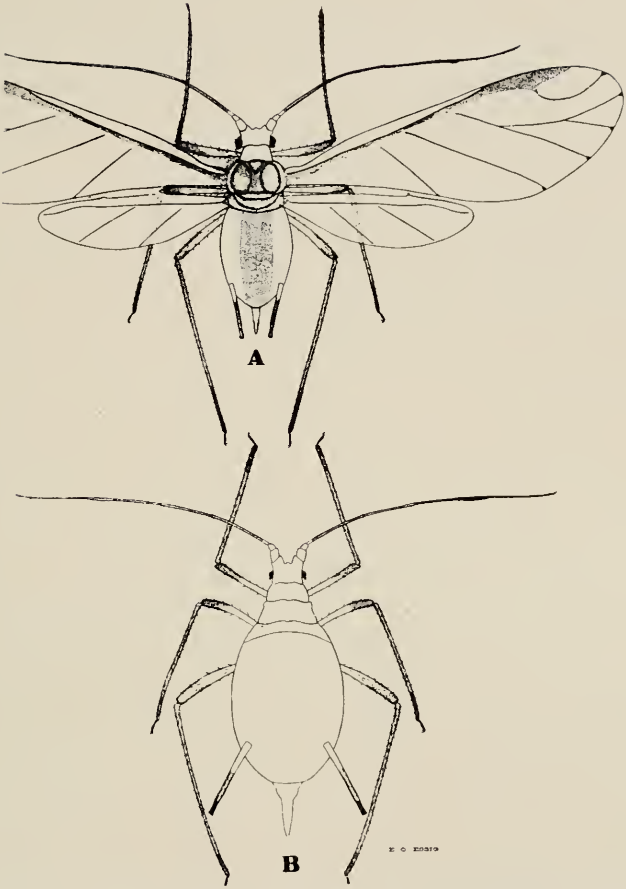


Fig. 58.—The green citrus louse, *Macrosiphum citrifolii* (Ashm.). Adult winged and apterous females. (Essig, P. C. Jr. Ent.)

THE DESTRUCTIVE PEA LOUSE.

Macrosiphum destructor (Johnson).

(Fig. 59.)

General Appearance.—A large, light-green apterous and winged form, 3 mm. long. Head and thorax of winged lice amber to yellow; red spots often occur on the abdomen.

Life History.—These lice occur practically throughout the entire year. In the winter they feed upon legumes in the mountains and in summer migrate to the cultivated fields. Due to their great prolificacy much damage is done, especially to pea crops during the summer months. In many localities entire fields have been ruined.

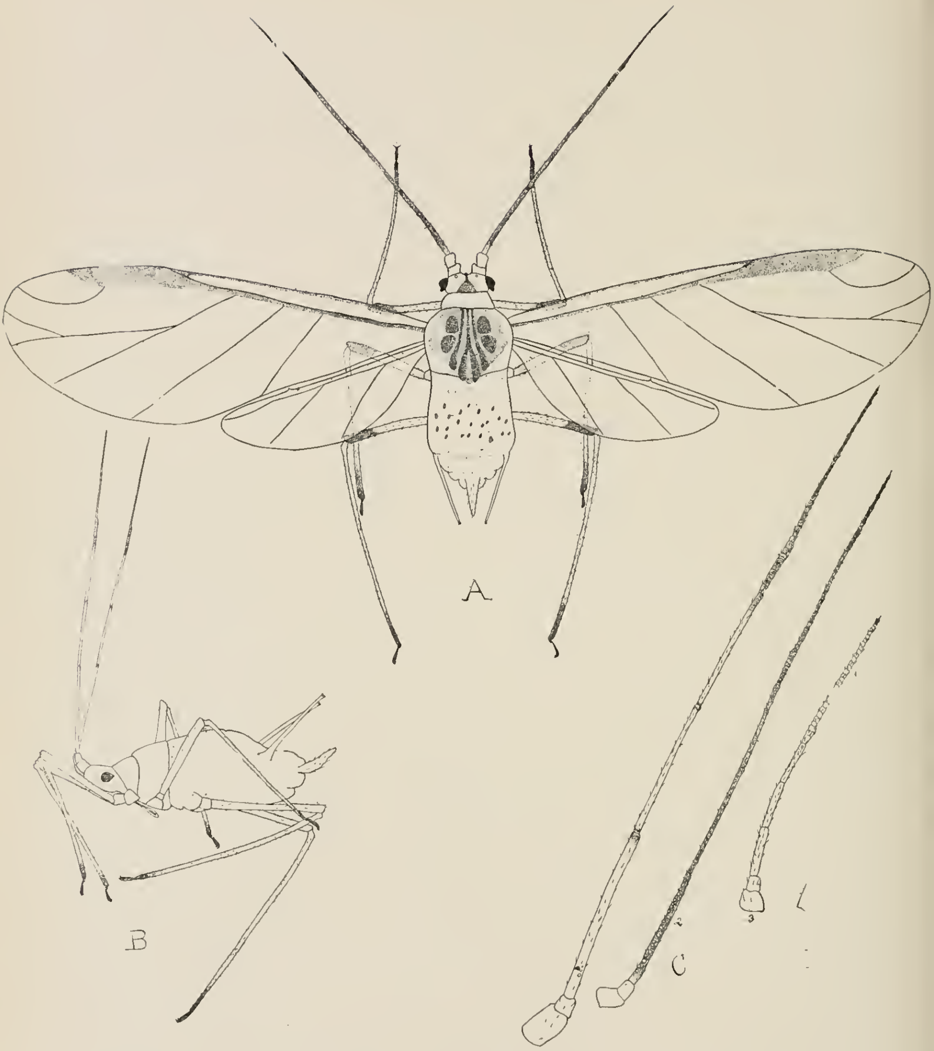


FIG. 59.—The destructive pea louse, *Macrosiphum destructor* (Johns.). A, adult winged female; B, lateral aspect of apterous female; 1, antenna of apterous female; 2, antenna of winged female; 3, antenna of nymph; 4, cornicle of adult; 5 and 6, cornicles of nymphs. (Essig, P. C. Jr. Ent.)

Distribution.—Throughout the entire State.

Food Plants.—Peas, vetch and other legumes.

Control.—Natural enemies do not hold this species in check at all. It is sometimes necessary to spray with a tobacco or emulsion spray. Such spraying can most profitably be done with a drive-geared spraying machine.

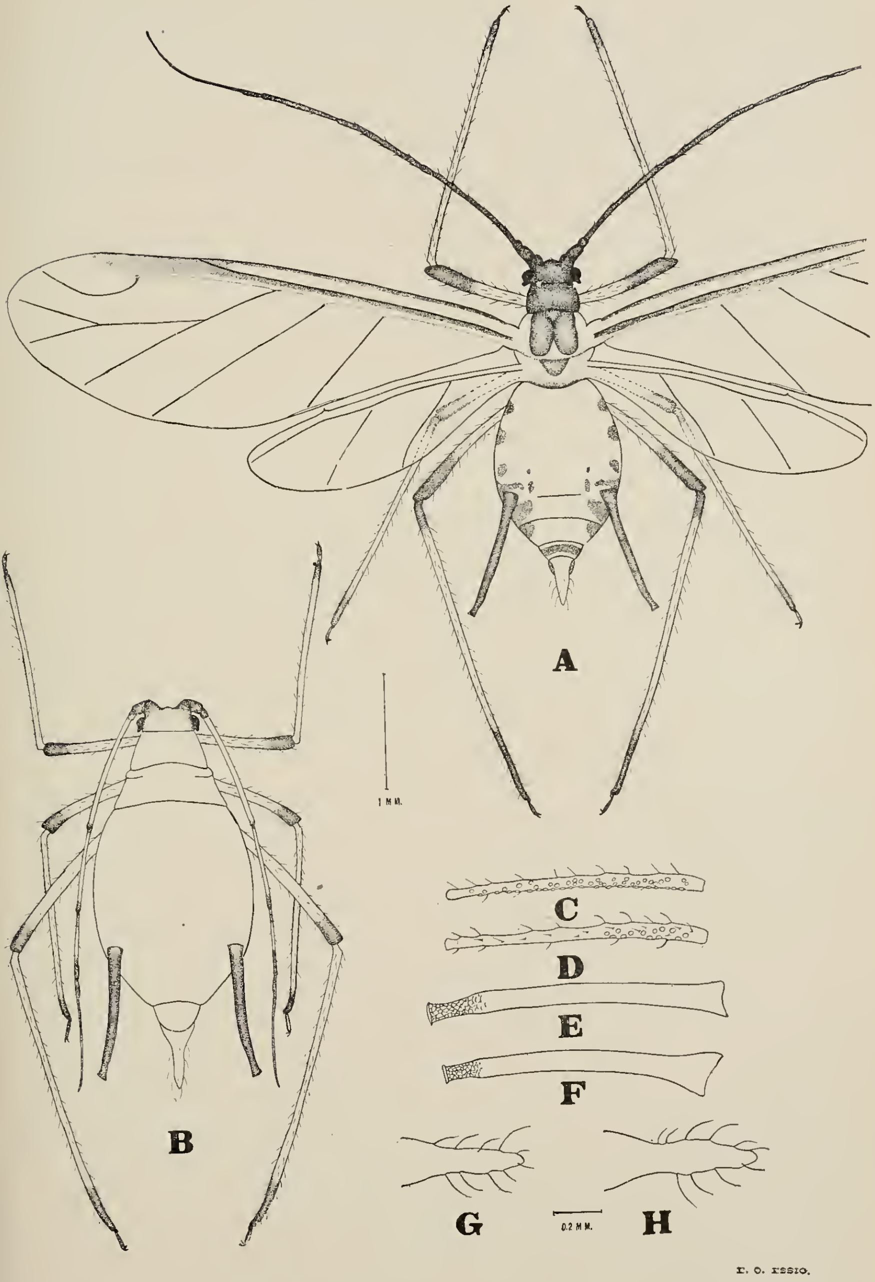

A
1 MM.
B
C
D
E
F
G
0.2 MM.
H
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Fig. 60.—The large rose aphid (*Macrosiphum rosæ* Linn.). A and B, adults; C, E and G, third antenna article, cornicle and style of winged female; D, F and H, same of the apterous female. (Essig, P. C. Jr. Ent.)

THE LARGE ROSE APHID.

Macrosiphum rosæ Linn.

(Fig. 60.)

General Appearance.—A large aphid, being green and pink in color. The apterous forms have dark cornicles and the joints of the legs and antennæ dusky, while in addition to these the thorax, entire antennæ and blotches on the sides of the abdomen of the winged forms are dark. Length, 2 to 3 mm. Readily distinguished from the other common green rose aphid by the large size and pink forms.

Life History.—Works on the young shoots and buds of the roses, almost throughout the entire year. Especially troublesome in the early spring during the months of April and May. Not so serious a pest on roses as is the small green louse (*Myzus rosarum*).

Distribution.—Throughout the entire State.

Food Plants.—Roses, wild and cultivated.

Control.—In order to save the buds it is sometimes necessary to spray the bushes with a soap and tobacco spray. Washing the bushes every day with a high pressure of water will keep them off and is a practical method of control.

Natural Enemies.—Natural enemies completely eliminate the attacks of this pest by the middle of summer.

RED VIOLET LOUSE.

Rhopalosiphum violæ Perg.

General Appearance.—All forms are dark red; the wings are noticeably clouded along the veins which easily distinguishes this species from all others infesting violets.

Life History.—Viviparous females, winged and apterous, bring forth young continually throughout the early spring and summer months. Evidently the entire life cycle is passed upon the violet.

Distribution.—Throughout the entire State; works on the tender shoots and undersides of the leaves.

Food Plants.—Cultivated violets.

Natural Enemies.—This species is usually held in perfect control by internal parasites.

BLACK CHERRY LOUSE.

Myzus cerasi Fab.

General Appearance.—A shining jet black louse, congregating in great numbers on the young and tender foliage. Particularly characterized by the long swollen cornicles or honey tubes. The young greatly resemble the adults, but are somewhat lighter in color.

Life History.—The lice hatch as soon as the buds open in the spring from over-wintering eggs deposited on the branches of the cherry trees and previous fall. Throughout the entire summer only females appear which have the power to reproduce their like—these being the destructive forms. In the fall, however, they give birth to true males and females, which mate, the females depositing the over-wintering eggs. The lice breed very rapidly and occasionally cause considerable trouble.

Distribution.—Throughout the central and southern parts of the State.

Food Plants.—The attacks of this pest are practically confined to the cherry, so it may readily be distinguished from all other black lice.

Control.—On old trees spraying with the emulsions, soap sprays and tobacco decoctions will control the pest. Young shoots which may become seriously infested near the tips, especially on nursery stock or small trees, can be dipped into a solution of these sprays.

Natural Enemies.—Natural enemies practically control the cherry louse. Many species of syrphid and green lacewing flies feed upon this species, while ladybird beetles share a large part in the work. In the east *Praon cerasaphis* Fitch is parasitic upon the lice and destroys great numbers.

THE GREEN PEACH APHID.

Myzus persicæ Sulzer.

(Fig. 61.)

General Appearance.—The color of this species varies from yellowish to rich green. The winged forms have dark olive-green head, thorax, and markings on the abdomen, as shown in Fig. 61. The apterous forms have no markings at all. This species is medium in size, varying from 1.5 to 1.9 mm. in length.

Life History.—The spring forms hatch from eggs deposited the former fall, and bring forth young just when the new foliage begins to appear. All twigs, and especially the tender growths are quickly attacked. Breeding continues throughout the entire spring and summer. In the fall males and females appear, and, copulating, give rise to the wintering eggs and the next year's broods.

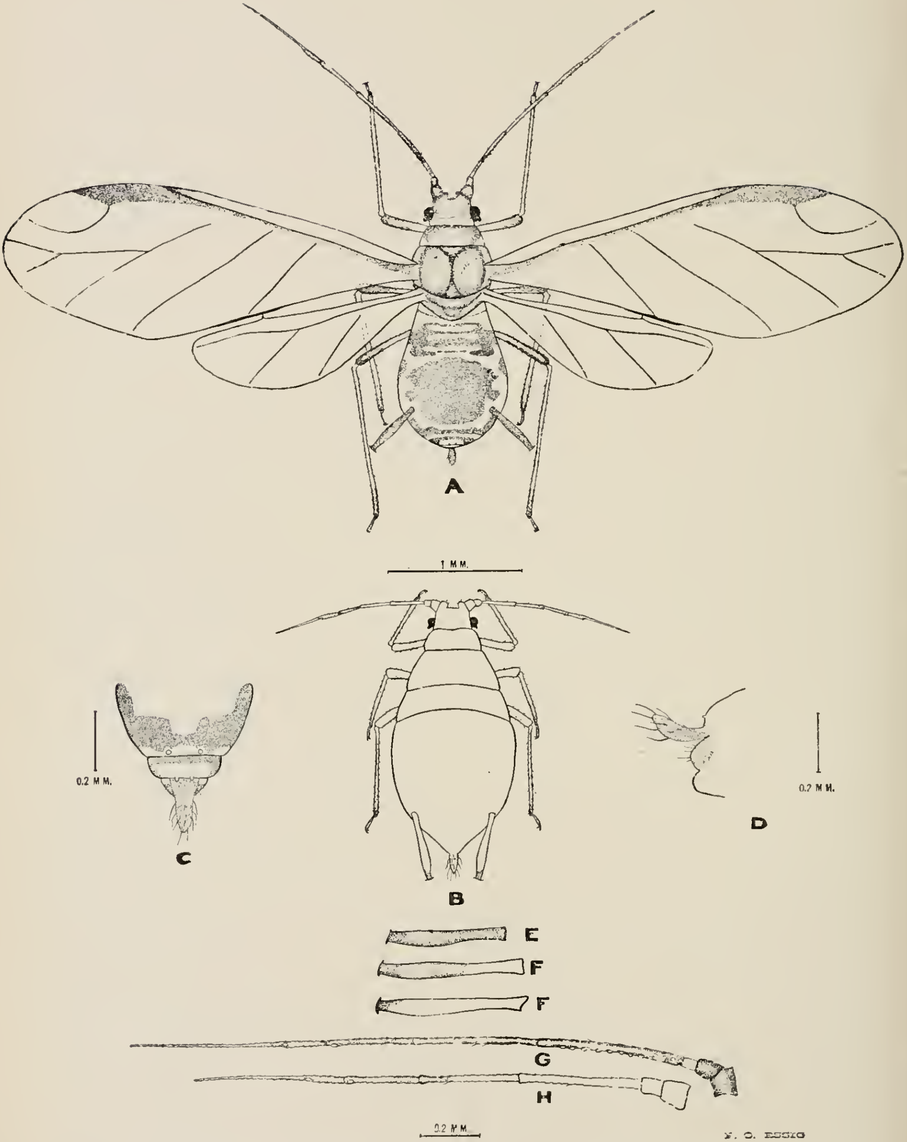

FIG. 61.—The green peach aphid (*Myzus persicæ* Sulz.). A and B, adult females; C, dorsal view of the pygidium of the winged female; D, side view of pygidium of apterous female; E and F, cornicles of winged and apterous females; G and H, antennæ of winged and apterous females. (Essig, P. C. Jr. Ent.)

Distribution.—Throughout the entire State. It is doubtful if there is a single locality where this species does not exist.

Food Plants.—Works on almost every kind of vegetation. Among the most common are: citrus trees (orange and lemon), potatoes, *Malva parviflora* L., and tomatoes. It has also been reported as feeding upon the following plants: *Amsinckia spectabilis* F. & M., *Brassica oleracea* (cabbage, cauliflower), celestial pepper (*Capsicum annuum* var. *abbreviatum* Fing.), *Chrysanthemum indicum* L., *Cynoglossum* sp., carnation (*Dianthus caryophyllus* L.), English ivy (*Hedera helix* L.), plum (*Prunus domestica* L.), peach (*P. persica* B. & H.), groundsel (*Senecio vulgaris* L.), *Sonchus asper* Vil., *Sonchus oleraceus* L., nettle (*Urtica urens* L.), *Prunus amygdalus*, cherry (*P. cerasus* L.), German ivy, *Prunus insititia*, *Malva rotundifolia*.

Natural Enemies.—Internal parasites and predaceous enemies usually make it unnecessary to adopt artificial methods of control.

SMALL GREEN ROSE LOUSE.

Myzus rosarum Walk.

(Fig. 62.)

General Appearance.—A very small species, not nearly as large as *Macrosiphum rosæ;* green throughout except dark markings on the winged forms. It is often mistaken for the larger species.

Life History.—A very serious rose pest at times, and especially bad in the summer months. It breeds very rapidly, collects in great numbers upon the leaves and excretes a great amount of honeydew which smuts the bushes. The worst rose pest in many parts of the State.

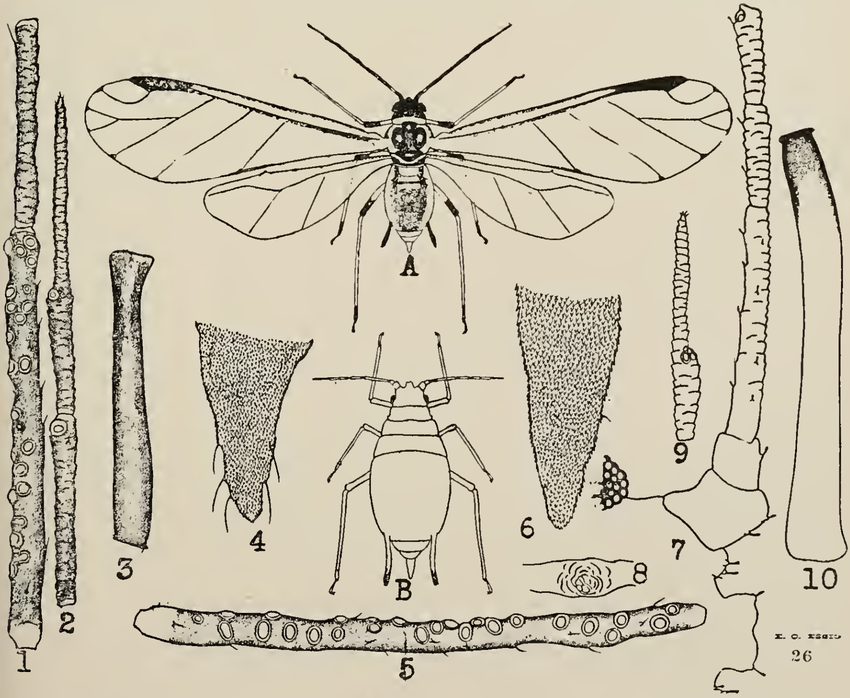

FIG. 62.—Small green rose louse (*Myzus rosarum* Walk.). A and B, adult females; 1 and 2, antennal articles, 3, cornicle, 4, style, 5, third antennal article of winged female; 6, style, 7 and 9, front and antenna, and 10, cornicle of apterous female. (Essig, P. C. Jr. Ent.)

Distribution.—Throughout the entire State.

Food Plants.—Roses, usually more serious on climbing varieties. Attacks the leaves and buds and may prevent the production of flowers.

Natural Enemies.—Syrphid flies do considerable work upon this species, but the natural enemies are not numerous enough to check the ravages until late in summer.

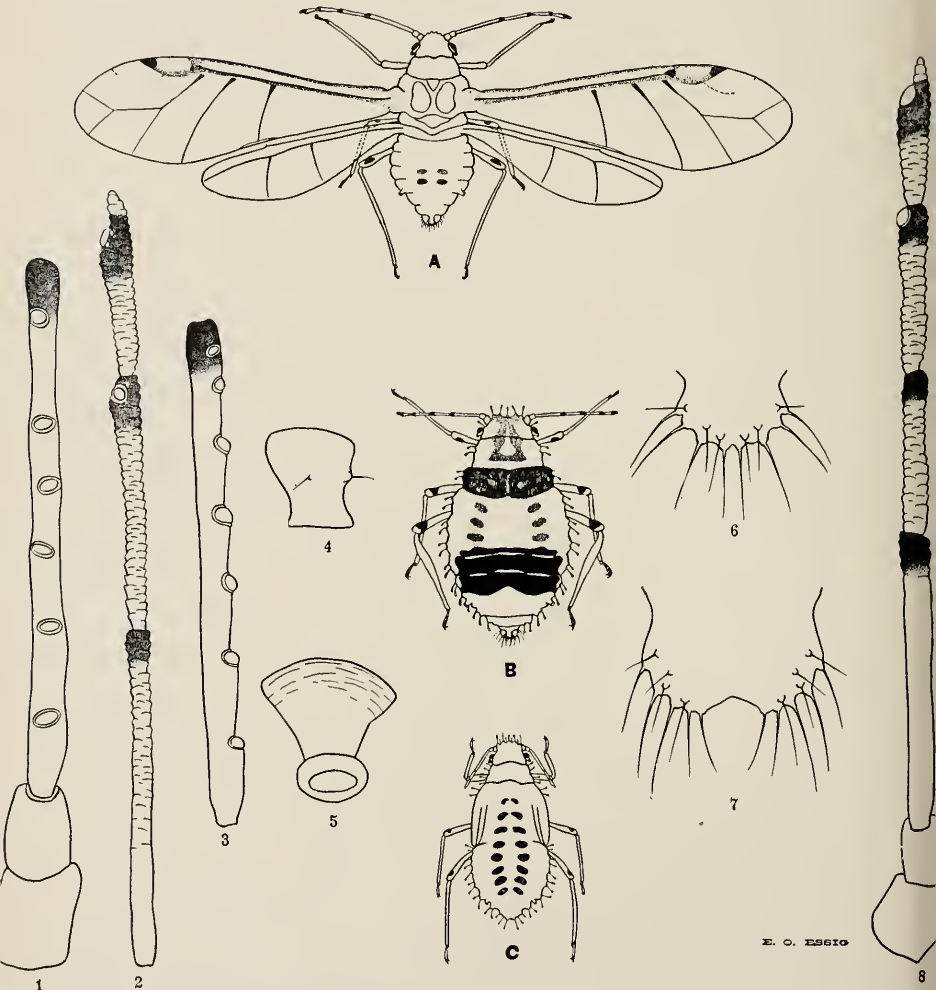

FIG. 63.—Walnut plant louse, *Chromaphis juglandicola* (Kalt.). A, adult winged viviparous female; B, adult apterous viviparous female; C, nymph of winged female; 1-3, antenna of winged female; 4, cornicle (honey tube) of winged female; 5, cornicle of apterous female; 6, style; 7, anal plate; 8, antenna of apterous female. (Essig, M. B. Cal. Hort. Com.)

THE WALNUT PLANT LOUSE.

Chromaphis juglandicola (Kalt).

(Fig. 63.)

General Appearance.—The presence of this louse is usually manifested by the smutting of the walnut trees during the early summer months. Close examination, especially of the under sides of the leaves will reveal the minute, light yellow lice. When magnified the winged lice will be found to have black markings on the antennæ, the middle and hind femora, and on the abdomen. The true wingless lice have two distinct broad black bands across the bodies.

Life History.—The sexual forms in the fall deposit eggs upon the branches. These hatch in the spring and give rise to great numbers of young which follow. The growing lice excrete a large amount of honeydew which covers the foliage and ground beneath the tree. This honeydew is responsible for the smutting. Late in July and in August the numbers gradually diminish and when the leaves begin to fall only the freshly laid eggs remain upon the branches.

Distribution.—Throughout the central and southern parts of the State.

Host Plant.—So far as known this louse works only upon the cultivated walnut.

Natural Enemies.—The most effective natural foe of this louse is the ashy gray ladybird beetle (*Olla abdominalis* Say). The work of this beetle is often phenomenal, so much so that in not a few seasons all of the lice disappear by midsummer.

THE WILD WALNUT LOUSE.

**Monellia californica* Essig.

(Fig. 64.)

General Appearance.—This louse is often confused with the walnut louse (*Chromaphis juglandicola* Kalt), which is so troublesome in the walnut orchards of Southern California. The difference in markings easily separates the two lice. All of the adult females appear to be winged, the young nymphs being the only apterous individuals observed. The adults are bright yellow in color with antennæ, a band on each side of the prothorax, the wing veins, the tibiæ and feet are dark—none of these markings being pronounced in the young.

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*The ending of the specific name should be "a" instead of "us," as first described.

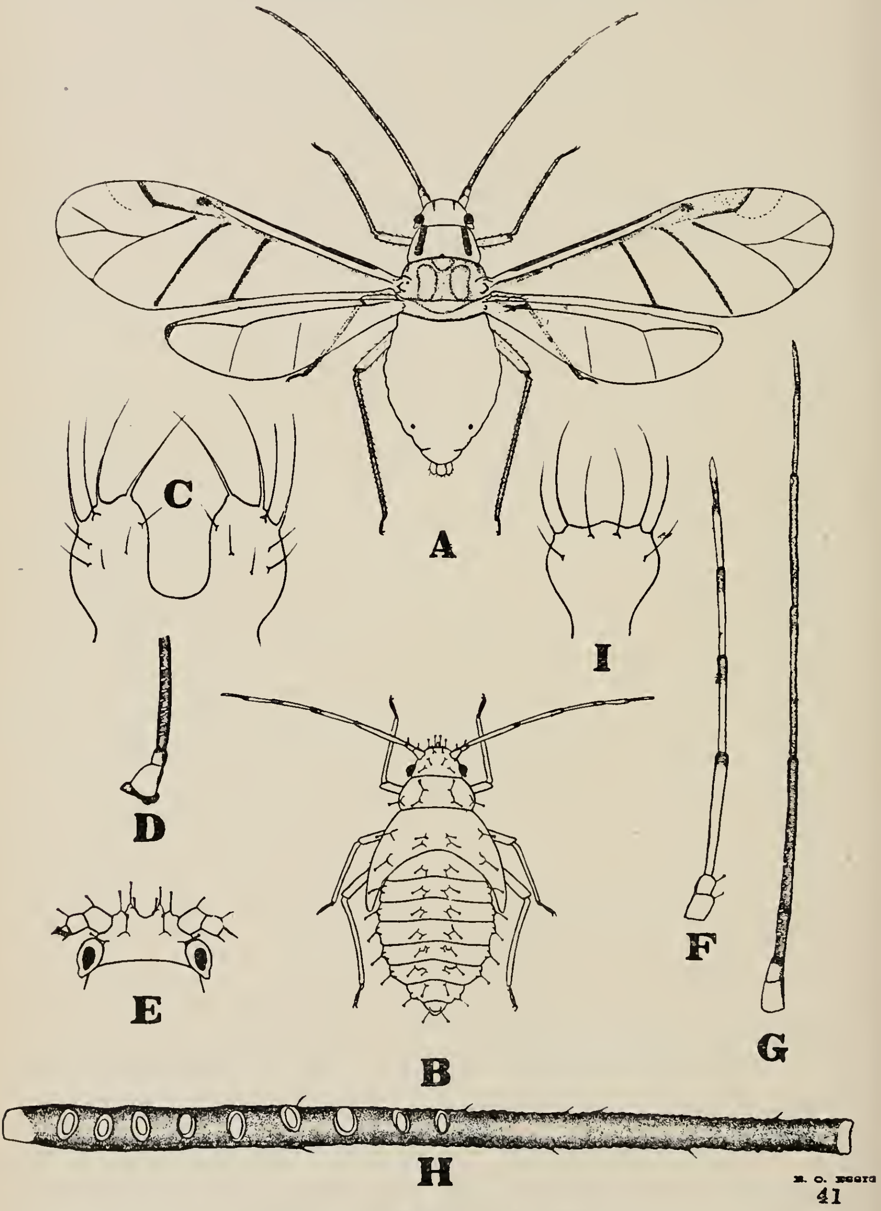

FIG. 64.—The wild walnut louse (*Monellia californica* Essig). A, adult female; B, nymph; C, anal lobe or plate; D, base of antenna, showing black ring around the first segment; E, head of nymph; F, antenna of nymph; G, antenna of adult; H, third antennal article of adult, showing sensoria; I, style. (Essig, P. C. Jr. Ent.)

Distribution.—Occurs in great numbers upon the wild walnut throughout the southern part of the State.

Food Plants.—The lice work upon the under sides of the leaves of the California black walnut (*Juglans californica*). Great colonies may often appear so as to completely cover the foliage and the amount of honey secreted is sufficient to cause smutting, rendering the trees very unsightly.

THE BAMBOO PLANT LOUSE.

Myzocallis arundicolens (Clarke).

(Fig. 65.)

General Appearance.—The adult lice are about one tenth of an inch long and pale yellow in color. Miscroscopic examination reveals the facts that the antennæ, the sides of the thorax, two rows of tubercles upon the abdomen, the wing veins and feet are light brown or dusky. The young lice show little or no markings. There appear to be no apterous females.

Distribution.—This pest is usually found wherever the bamboo is grown. It has been collected at Santa Barbara, San Francisco, and Sacramento, and probably occurs very generally over the central and southern parts of the State.

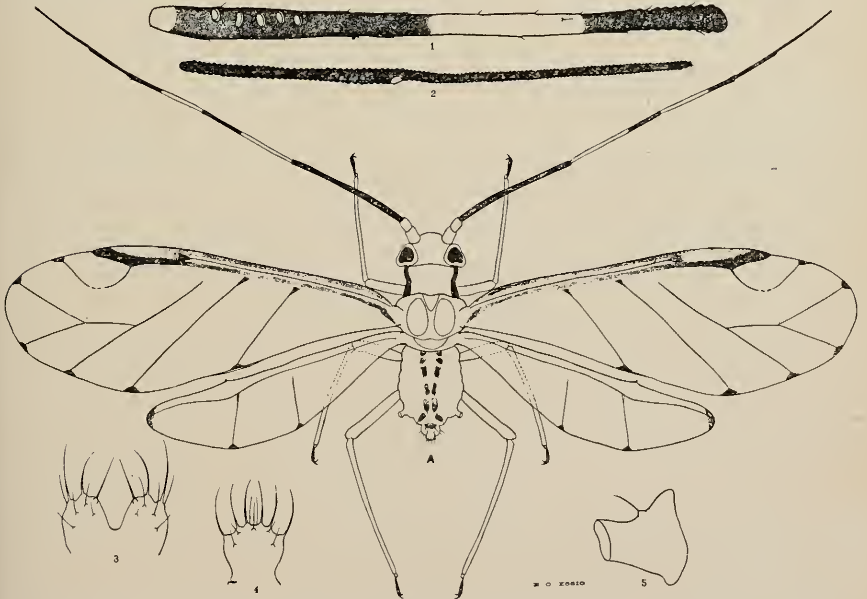

Fig. 65.—The bamboo plant louse, *Myzocallis arundicolens* (Clarke). A, adult female; 1, third antennal article; 2, sixth antennal article; 3, anal lobe or plate; 4, style; 5, cornicle. (Original.)

Food Plant.—The lice feed upon the under sides of the leaves or blades of bamboo, often collecting in large colonies and doing much damage by weakening the plants and smutting the foliage.

THE COMMON COTTONWOOD LOUSE.

Thomasia populicola (Thos.).

General Appearance.—The adults are dark red or wine colored, many appearing nearly black and are distinguished from other poplar lice by the clouded wings. The winged forms are much darker than the apterous, which are distinctly robust and are characterized by a yellow blotch on the back, not unlike an inverted "Y." This species clusters in great colonies at the terminals of young shoots.

Life History.—So far as known the entire life cycle is passed upon cottonwood trees. During the early summer months the young shoots of the host plants are seriously attacked, but by fall all entirely disappear. It is not known how the winter is spent.

Distribution.—Throughout the entire State wherever the food plants grow.

Food Plants.—The common cottonwood (*Populus trichocarpa*) and poplar are invariably infested by this louse.

Natural Enemies.—Though this pest does considerable damage to young growth during the summer months, it is finally checked by many natural enemies, chief of which is the native ladybird, *Scymnus nebulosus*.

THE HOP LOUSE.

Phorodon humuli Schrank.

(Fig. 66.)

General Appearance.—The wingless lice are pale yellowish-green; the winged lice being of the same general color with head, dorsum of the mesothorax and spots on the abdomen, dark.

Life History.—The life history of this louse greatly resembles that of the mealy plum louse. The over-wintering eggs are laid upon the fruit trees in the fall. The spring broods breed and feed upon the leaves until the hops begin to appear. By this time winged forms occur in large numbers and these migrate to the hop fields where the summer is spent. The young plants and foliage of the hop vines are severely damaged by this pest, so as to completely ruin portions of the fields. In the fall, migrants again return to the fruit trees, and give birth to the sexual forms which produce the over-wintering eggs. The sexual forms occur in the hop fields while the lice may be found upon the plum trees during the summer, so in all probability they can exist upon either of these hosts through the season.

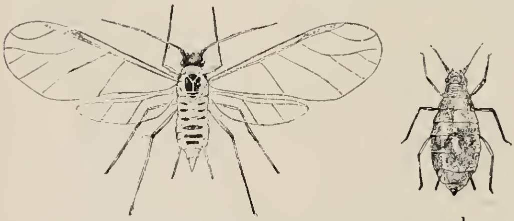

Fig. 66.—Winged and apterous females of the hop louse, *Phorodon humuli* Schrank. (After Riley.)

Distribution.—Very common and destructive, especially in the central hop-growing districts of the State.

Food Plants.—This is primarily a hop pest and is certainly one of the worst enemies of that crop. It also feeds upon plum trees, occurring upon either hops or plums throughout the summer.

THE PARSNIP LOUSE.

Hyadaphis pastinacæ (Linn.).

(Fig. 67.)

General Appearance.—The apterous forms are pale apple green, occasionally with small red spots on the dorsum. The winged forms are green with dark head, antennæ, thorax, middle of the abdomen, tips of cornicles and leg joints. The species is recognized by the small tubercle on the posterior of the abdomen just above the style.

Life History.—This is one of the most widely spread species, occurring on many hosts throughout the early spring and summer months. Due to its varied host plants it seldom becomes serious on any one of them.

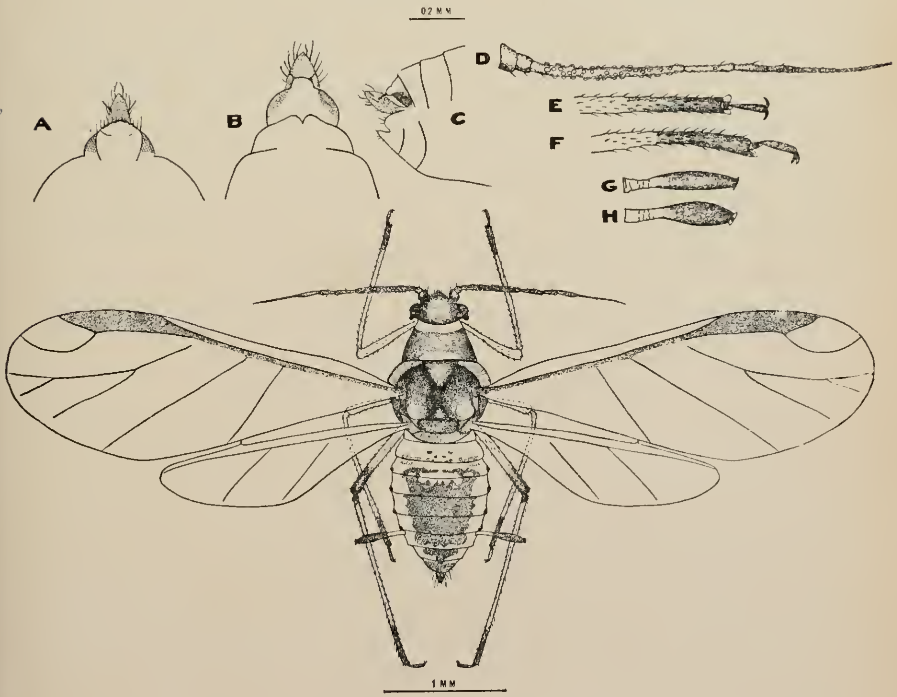

Fig. 67.—The parsnip louse, *Hyadaphis pastinacæ* (Linn.), winged female and detailed drawings of characteristic appendages. (Essig, P. C. Jr. Ent.)

Distribution.—Throughout the entire State.

Food Plants.—Carrots, parsnips, celery, willows, including *Salix aurea*, *S. lucida*, *S. nigra*, *S. caprea*, *S. babylonica*, *S. alba*, and *S. amygdaloides*, *Pimpinella magna*, *P. saxifraga*, *Erysimum vulgare*, *Archangelica atropurpurea*, *Zizia aurea*, *Cicuta virosa*, *Heracleum sphondylium*, *Ægopodium podagraria*, *Chærophyllum temulum*, *Angelica sylvestris*.

Natural Enemies.—Especially preyed upon by the larvæ of syrphid flies.

THE MEALY PLUM LOUSE.

Hyalopterus arundinis Fab.

General Appearance.—The adult lice are long and slender, light green with three darker longitudinal stripes on the back and covered with a white powder from whence it gets its name. It usually occurs in large colonies on the under sides of plum and prune leaves, causing them to turn yellow and drop but not to curl.

Life History.—The first broods hatch in the spring from the black shining eggs deposited upon the twigs of the trees the previous fall by the sexual females. These lice settle upon the under side of the first leaves and bring forth young which soon mature and produce others. During the summer in July and August the lice, most of which have acquired wings by this time, leave the trees and feed upon grasses; the fall migrants returning to the trees to give birth to the true sexual winged males and wingless females, which mate—the females laying the over-wintering eggs.

Distribution.—Especially abundant in the central part of the State in the Sacramento and San Joaquin valleys, as well as along the coast and in the Sierra foothills.

Food Plants.—The only fruit trees attacked appear to be the prune, apricot and plum. The common reed grass (*Phragmites vulgaris*) is also infested.

THE BLACK CITRUS LOUSE.

Toxoptera aurantiæ Koch.

(Fig. 68.)

General Appearance.—A small dull black louse, scarcely over 1.5 mm. in length. The apterous forms often appear brown, while the young are a decided reddish-brown to black. Some of the adults are shiny black and have been mistaken for the black peach aphis (*Aphis persicæ-niger*). It is easy to distinguish the winged individuals of this species by the very dark and prominent stigma and the single branching of the third discoidal vein.

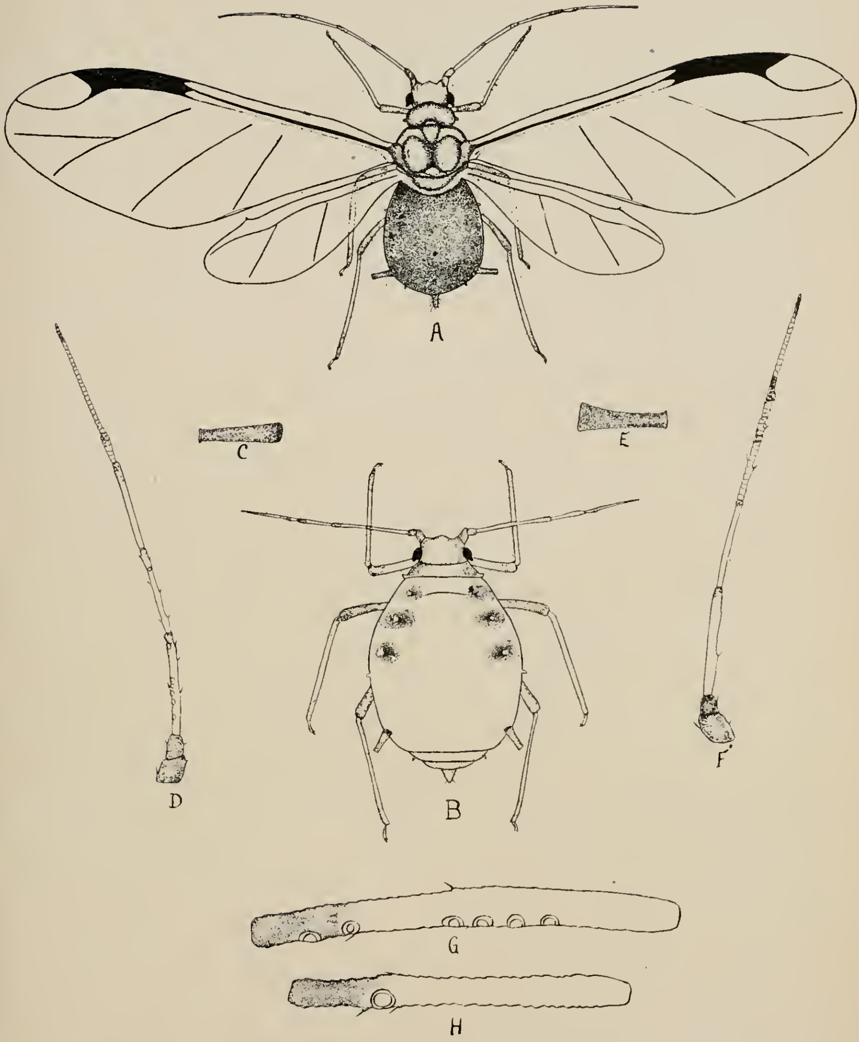

FIG. 68.—The black citrus louse (*Toxoptera aurantiæ* Koch). A and B, adult females; C, cornicle and D, antenna of winged female; E and F, same for apterous female; G, third, and H, fourth antennal articles of winged female. (Essig, P. C. Jr. Ent.)

Life History.—This species may be found in the citrus groves throughout the entire year, all stages being present. The greatest numbers occur during the spring months, when all the new growth may be destroyed on the young trees by them. Older trees are also attacked. The presence of the insects on the larger and older leaves is easily told by their curled appearance, a condition produced by the lice.

Distribution.—Throughout the entire citrus growing section of the State. Especially abundant in the southern coast counties.

Food Plants.—All species of citrus trees, camellia, *Olea straussia* and coffee.

Natural Enemies.—This insect would be a far greater pest were it not for its many natural enemies. Two internal parasites, *Aphidius testaccipes* Cress. and *Charips xanthopsis*, have been bred from adult lice, while the California ladybird beetle (*Coccinella californica*) and the larvæ of three syrphid flies (*Allograpta obliqua* Say, *Syrphus americanus* Wied. and *Lasiophthicus pyrastri* Linn.) were observed in large numbers feeding upon the lice.

COCCIDÆ (Family).

SCALE INSECTS.

To the California horticulturist, and especially to the citrus grower, the scale insects are by far the most destructive and persistent pests. More money is spent in combating them than all other insects together.

Many members of the family have the ability to produce a scale-like covering, from whence the name scale insect comes, while others, though unable to form a scale, secrete a hardened chitinous shell; while still others secrete an abundance of white, cottony wax for protective purposes.

The young are either born alive or from eggs previously laid by the female. They always have legs, enabling them to move about freely. In many species the legs are retained throughout the entire life cycle, enabling the adults to move as freely as the young, but in the scale-bearing species the legs disappear in the females, there being but a small body under the shell, while in the case of the males the moults are undergone under the scale, the adult appearing as two-winged, very delicate insects.

Control.—The control of scale insects has long been one of great importance throughout the entire country. Formerly only sprays were used in combating them, but during the past few years fumigation, especially in the citrus growing sections of the state, has become the principal control method. Scale insects occurring on deciduous fruit trees are most efficiently and cheaply controlled by the use of sprays, and the mealy bugs on citrus and other trees are also subjected to a similar treatment. All armored scales as well as such unarmored scales, as the black and soft-brown, on citrus trees are most effectively controlled by fumigation.

Natural Enemies.—One of the most noted examples of the control of a serious insect pest by natural enemies is that of the cottony cushion scale, *Icerya purchasi*, by the Vedalia, *Novius cardinalis*. Other ladybird beetles and internal parasites also form an important part in the control of scale insects, being responsible for the complete subjection of certain non-economic species. Many other insects also prey upon coccids, as will be noted in the discussion of the various species.

In this work five subfamilies will be considered as follows:

Monophlebinæ.
Ortheziinæ.
Dactylopiinæ.
Coccinæ.
Diaspinæ.

MONOPHLEBINÆ (Subfamily).

The females belonging to this subfamily are characterized by secreting, behind the soft and unprotected bodies, a large white cottony egg-sac. The bodies of the young scales are almost entirely without protective covering, as are also those of the adult females. The males are delicate, two-winged insects. In California we have but one species, *Icerya purchasi*, including two varieties of *crawii* and *maskelli*, of economic importance.

THE COTTONY CUSHION OR FLUTED SCALE.

Icerya purchasi Mask.

(Figs. 69, 70.)

General Appearance.—The adults are distinguished by large, white fluted cottony masses with distinct red or yellow bodies, varying from one fourth to one half inch in length and three fourths as wide. There are two varieties as follows: *Icerya purchasi* var. *crawii* Ckll., of which the body proper is yellow or light brown, and *Icerya purchasi* var. *maskelli* Ckll., the body of which is very dark brown or almost black. The eggs and young are bright cardinal red.

Life History.—The large cottony masses are the egg-sacs of the females, and may contain from four hundred to a thousand eggs. The males soon after hatching secrete themselves in a white cocoon for transformation, which requires nearly one month. The females are matured in from three to four months. There are several broods during the summer, when the scale increases enormously and may do great damage.

Distribution.—Throughout the citrus growing section of the entire State, but due to its natural enemies is seldom seen in some localities while in others it may become serious.

Food Plants.—All citrus trees, *Acacia baileyana*, *Acacia melanoxylon*, pomegranate, quince, apple, peach, apricot, fig, walnut, locust, willow, pepper, grape, rose, castor bean, spearmint, rose geranium, purslane, ambrosia, *Polygonum*, nettle, sweet-gum, *Verbena*, *Veronica*, *Magnolia*,

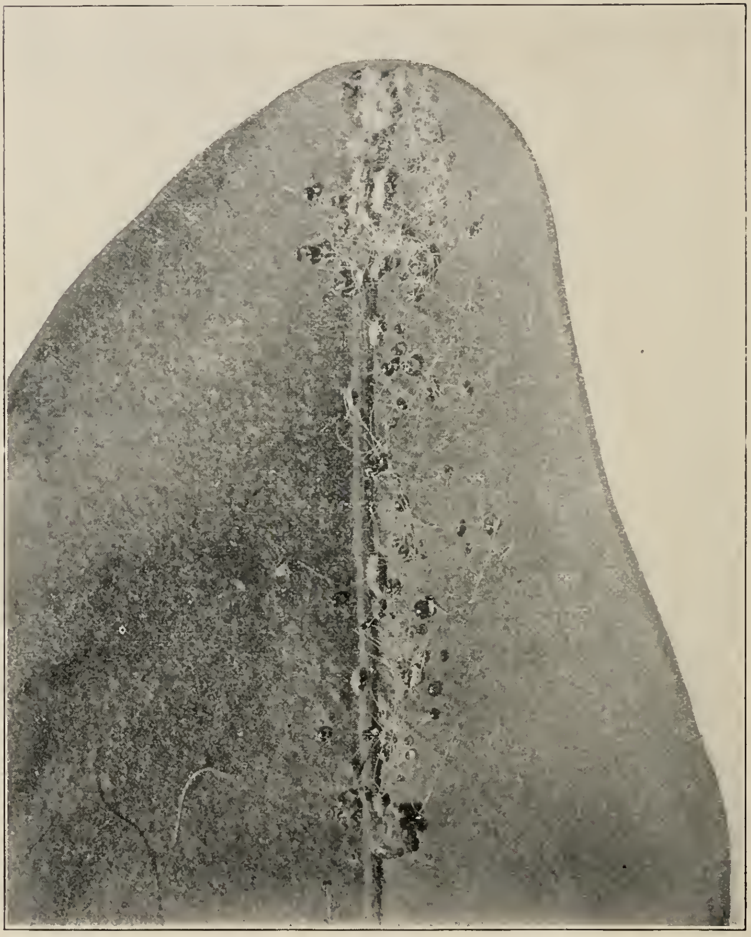

FIG. 69.—Young cottony cushion scale on lemon leaf, showing honey threads and drops secreted by them. (Essig, P. C. Jr. Ent.)

white oak, flowering almond, pecan, potato, nightshade, *Amaranthus*, *Chenopodium*, Bermuda grass.

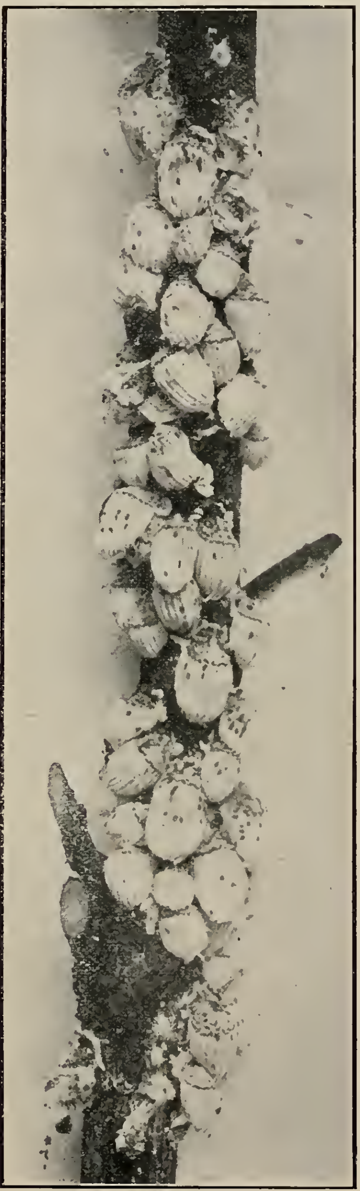

FIG. 70.—Cottony cushion scale (*Icerya purchasi* Mask.) on orange twig. (Cal. Hort. Com.)

Control.—Artificial control by sprays and fumigation are never practiced because of the efficiency of natural enemies. This is the one case where nature controls perfectly a serious pest.

Predaceous Enemies.—The common Vedalia (*Novius cardinalis*) and the Kœbele's ladybird (*Novius kœbelei*) are the ladybird beetles which keep the cottony cushion scale in complete subjection. In many localities the former is the most efficient, but in some places, and especially in Ventura County, the writer found the latter doing most of the control work.

While these ladybirds are usually present in limited numbers in most sections, yet at times they completely disappear and the cottony cushion scale increases so as to cause considerable damage before the beetles can again be established. It is always well to keep a close watch of this pest, and if it appears without being accompanied by the larvæ of the Vedalias, adults of the latter should be obtained and liberated as soon as possible.

True Parasites.—There are two true parasites which also prey upon this coccid: the hymenopterous enemy, *Ophelosia crawfordi*, and the dipterous parasite, *Cryptochætum* (*Lestophonus*) *iceryæ* Will. The latter is often responsible for as much effective work as are the Vedalias, though this fact is not generally known.

ORTHEZIINÆ (Subfamily).

The members of this subfamily are soft-bodied insects without special protection. The females are characterized by their long white egg-sacs at the posterior end of the body as shown in Fig. 71, and their long legs. The bodies are also slightly covered with a white wax. Throughout the entire life cycle the females are very active. But one species, *Orthezia insignis*, is of economic importance in California.

THE GREENHOUSE ORTHEZIA.

Orthezia insignis Dougl.

(Fig. 71.)

General Appearance.—Body ochreous to dark green, covered with plates of white waxy secretion, which are extended posteriorally in a large rectangular plate, to hold and protect the eggs and young. Length 1.5 mm. Males are small and darker in color with two long, white wax filaments posteriorally.

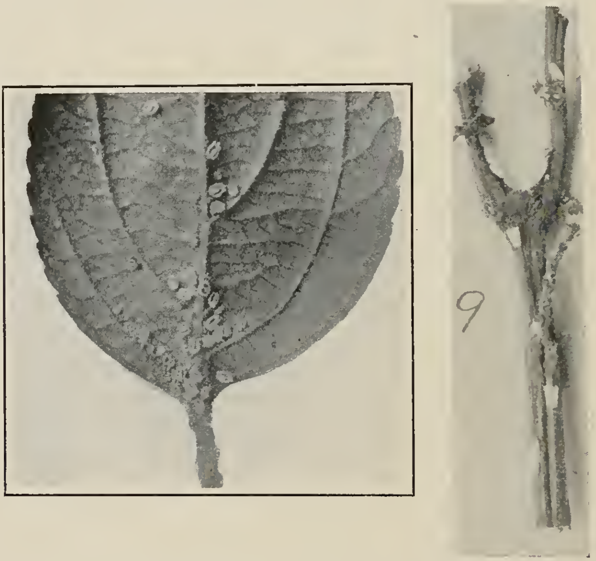

Fig. 71.—The greenhouse orthezia (*Orthezia insignis* Dougl.). Immature forms at left (after Britton); adult females at right (after Craw.).

Life History.—There are several generations a year. The eggs of the female are carried in the white egg-sac fastened to the posterior end of the abdomen. The young females vary from yellow to green in color. As they grow the white covering forms around the edges and as a distinct middle longitudinal ridge. When full grown the bodies are completely hidden. All stages are active.

Distribution.—In greenhouses throughout the entire State and country.

Food Plants.—Is especially destructive to *Coleus* sps. It also attacks *Amaranthus* sp., *Chrysanthemum*, *Lantana*, *Verbena*, *Ipomœa*, *Thun-*

bergia, Strobilanthes, Achillea, Salvia, Cuphea, Capsicum, Ageratum, Vernonia, Gardenia, Lonicera, Citrus sp., tea, strawberry and tomato.

DACTYLOPIINÆ (Subfamily).

The members of this subfamily are much more varied than those of the two preceding. In some species the power of locomotion is retained throughout the entire life cycle, while in others the legs disappear early and the insect soon becomes fixed in position. The bodies are entirely unprotected except by the secretion of a white cottony powder or wax. The eggs may be enclosed in the secretion covering the females or they may be deposited in cottony masses. The chief members of this subfamily are the mealy bugs, which are very troublesome in this State.

THE EUROPEAN ELM SCALE.

Gossyparia spuria (Modeer).

(Fig. 72.)

General Appearance.—Adult females are readily distinguished by the white cottony borders around the reddish-brown bodies. They are from one fourth to nearly three eighths of an inch long, and are usually clustered in the cracks and crevices in great numbers and from a distance appear to be white rings. The male cocoons are white and less than one twelfth of an inch long. The young scales are very minute and grayish.

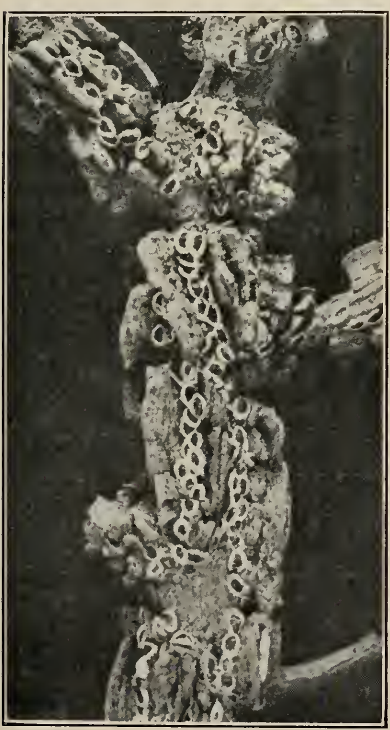

Fig. 72.—The European elm scale, *Gossyparia spuria* (Mod.) on cork elm. (After Doten.)

Life History. — The eggs are oblong in shape, pale yellow and hatch very quickly. The young appear during the early spring months and settle upon the leaves until August or September. When nearly grown, they move to the twigs and branches for hibernation. The males appear in the spring to mate with the females before they bring forth the summer brood. There is but one brood a year.

Distribution. — The spread of this pest is at present limited to the following localities: San Rafael, Ukiah, Stockton, Colusa, Palo Alto, Santa Clara and San José.

Food Plants.—White or American elm (*Ulmus americana*), and cork elm (*Ulmus racemosa*).

Control.—Washing with an extension nozzle under high pressure during the period of hatching will control the pest, if thoroughly done.

Distillate caustic-soda water mechanical mixture or lime-sulphur (1–9) when the trees are dormant are efficient.

Natural Enemies.—Dr. A. J. Cook found that the two-stabbed ladybird beetle (*Chilocorus bivulnerus*) was preying upon the elm scale at San Rafael.

THE MARLATT SCALE.

Phœnicococcus marlatti Ckll.

(Fig. 73.)

General Appearance.—The young scales only have power of locomotion, which they lose as they grow older. The adult females are not protected by a shell or scale, but secrete around and partially over themselves a white wax. They are about 1 mm. long, oval, wine red in color, and assembled in great colonies at the base of the leaves.

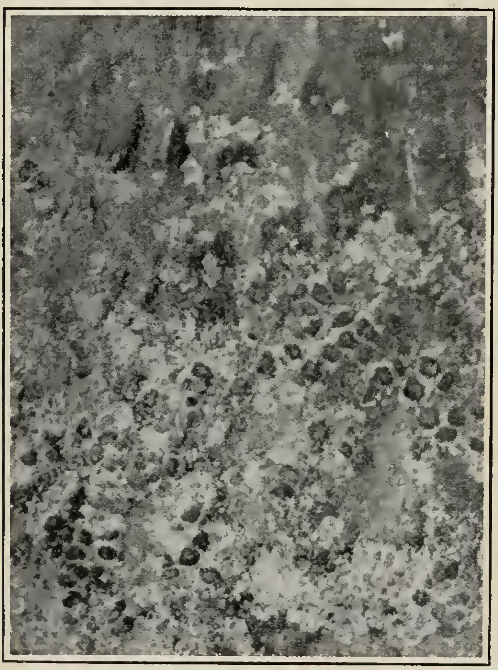

FIG. 73.—The Marlatt scale, *Phœnicococcus marlatti* Ckll. (After Cockerell.)

Life History. — Very little of the true life history of this coccid is known, except that it is a very troublesome pest to the date palm. The females give birth to living young, which appear in great numbers in the early spring. These seek the base of the palm leaves, where they are thoroughly protected before they settle to feed. Gradually the legs disappear and white wax is secreted to cover and protect the naked body. The male is unknown. The prolificacy of this species is a pronounced characteristic.

Distribution. — Limited to the southern part of the State, in Riverside and Imperial counties, where dates are commercially grown.

Food Plants.—Feeds at the base of the leaves of the commercial dates.

Control.—Carbolic acid emulsion poured in large quantities at the bases of the leaves until the trunk is thoroughly saturated has afforded best results, according to County Horticultural Commissioner W. H. Wilsie.

Natural Enemies.—No natural enemies have been found working upon this scale.

THE DIPLACUS CEROPUTO.

Ceroputo yuccæ Coq.

(Fig. 74.)

General Appearance.—This insect is continually mistaken for the regular mealy bugs belonging to the genus *Pseudococcus.* It differs in having a tooth on the inner surface of the claw, and a row of spine-groups on each side. The cottony covering is very dense and arranged in broad segmental plates. The males are nearly half an inch long, with dark and orange colored bodies, and long anal filaments. The cocoons are elliptical in shape, white in color and scattered among the females.

Life History.—The young are born alive and soon secrete wax enough to completely cover them. The broods appear in the late spring and early summer, and are especially abundant during the months of April, May, June and July. The males mature when the females are about two thirds grown; the life period of the females being from three to five months. This species lives under the ground on roots of black sage (*Ramona stachyoides*) and above ground on other plants. As an aerial form it does not appear until late in the season. The adults in all probability hibernate under ground in winter.

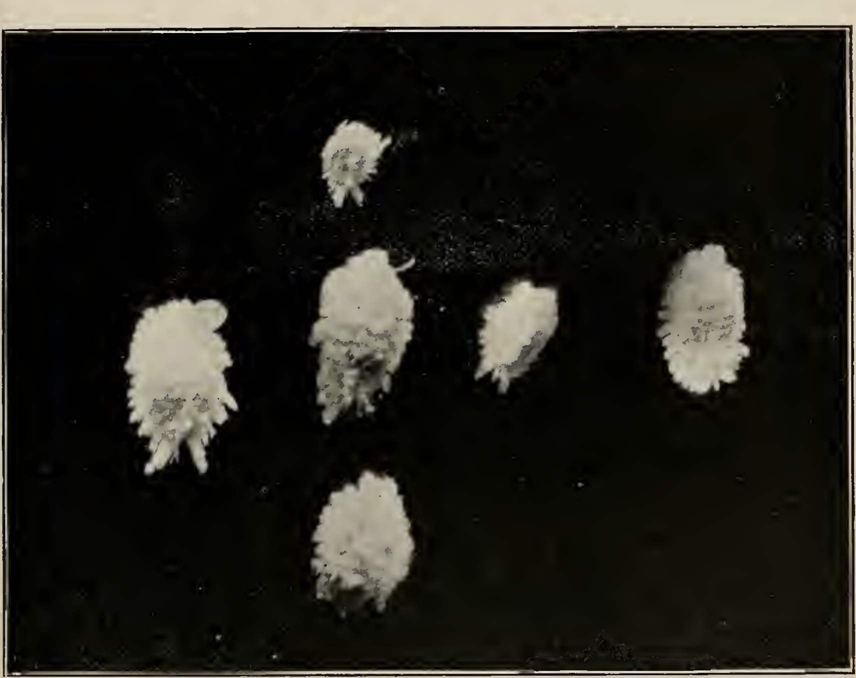

FIG. 74.—Adult females of the diplacus ceroputo, *Ceroputo yuccæ* Coq. (Essig, P. C. Jr. Ent.)

Distribution.—From Santa Cruz County south along the coast and in the interior. So far it has been taken in the following counties: San Mateo, Ventura, Los Angeles, San Bernardino and Orange.

Food Plants.—Black sage (*Ramona stachyoides*), the mountain monkey flower (*Diplacus glutinosus*), *Mesembryanthemum* sps. The species was taken on the first two hosts by the writer, and on the last by B. B. Whitney, who found it in great quantities along the foothills of San Mateo County. First taken by Coquillett on *Yucca whipplei.* Also on *Y. filifera*, *Y. australis*, *Lantana*, *Ceanothus hirsutus*, banana, orange, lime.

Natural Enemies.—Coquillett bred an internal parasite from specimens taken in Los Angeles County. This he named *Blastothrix yuccæ* Coq.

THE ARTEMISIA MEALY BUG.

Pseudococcus artemisiæ Essig.

(Fig. 75.)

General Appearance.—Much narrower than the usual forms, though

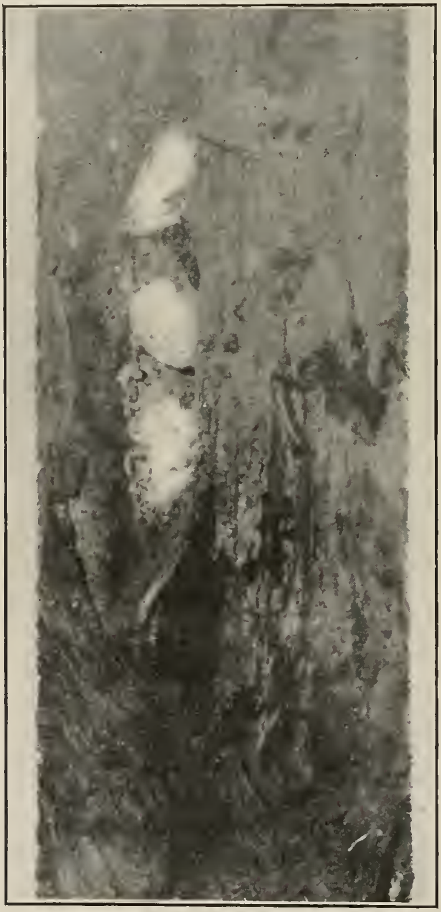

Fig. 75.—The artemisia mealy bug (*Pseudococcus artemisiæ* Essig) on branch. (Essig, P. C. Jr. Ent.)

rather small, being from one eighth to three eighths of an inch long. The color is slate but the fine powdery covering makes it appear gray. The segmentation is clearly seen through the white coat.

Life History.—The female deposits her eggs in a small sac in which she encloses herself. The species appears in the spring and summer months, but is very limited in numbers.

Distribution.—In the vicinity of Claremont, Los Angeles County.

Food Plant.—The California sage (*Artemisia californica*) is the only known food plant. The mealy bugs hide and feed under the bark and in wounds.

THE GOLDEN OR ARAUCARIA MEALY BUG.

Pseudococcus aurilanatus (Mask.).

(Fig. 76.)

General Appearance.—The body is deep red and covered with bright yellow or golden flocculence or waxy secretion. This species has no prominent anal appendages. The males are very minute and deep purple in color.

Life History.—The deep red or wine-colored eggs are deposited in loose masses of yellowish cottony wax. The young and adults move slowly and feed on the branches, crowding down between the needles or leaflets, often in great numbers. In such cases considerable smutting of the foliage results.

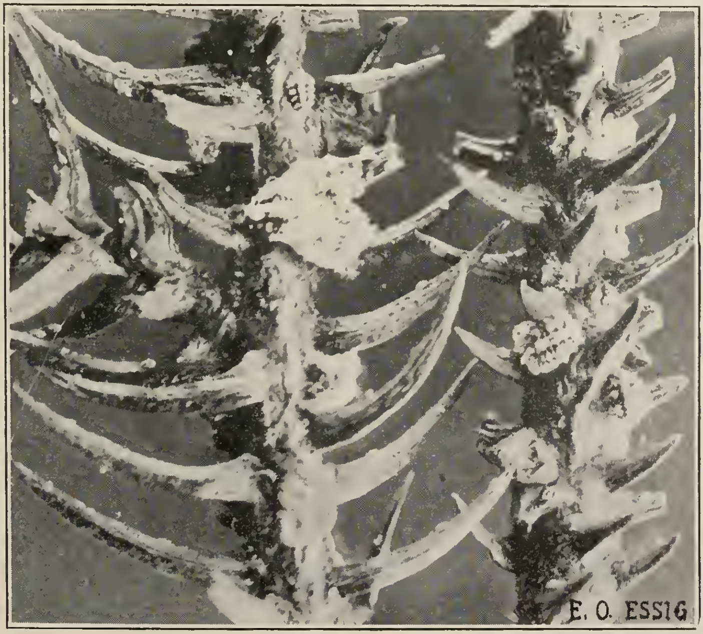

Fig. 76.—The golden or araucaria mealy bug, *Pseudococcus aurilanatus* (Mask.) on twigs of Norfolk Island pine. (Original.)

Distribution.—Throughout the State in greenhouses and in the open in the southern part.

Food Plants.—Norfolk Island pine (*Araucaria excelsa*), the Monkey Puzzler (*Araucaria bidwillii*), *Dammara ovata* and *D. vitiensis* are attacked.

Control.—Same as for the citrus mealy bug.

THE WALNUT MEALY BUG.

Pseudococcus bakeri Essig.

(Fig. 77.)

General Appearance.—Slightly larger than the citrus and long-tailed species. Does not secrete as much cottony covering and has tails half as long as the body.

Life History.—Eggs are deposited in loose masses similar to those of the citrus mealy bug. Does not multiply nearly as rapidly as the other species.

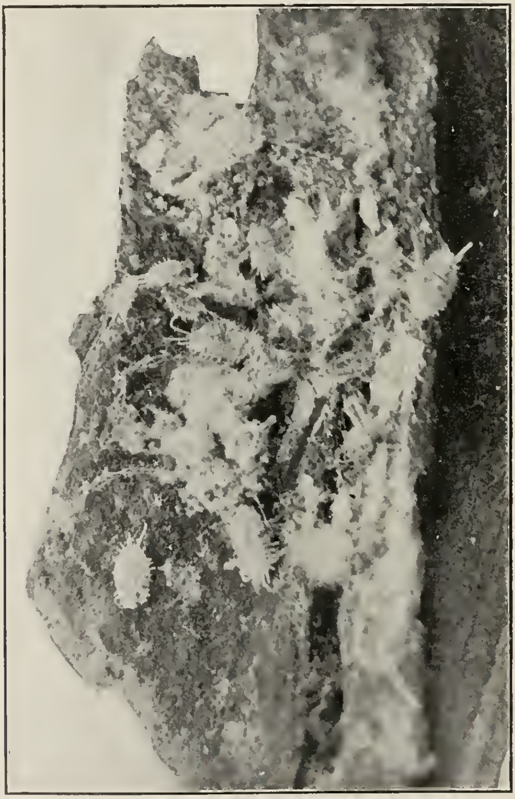

FIG. 77.—Walnut mealy bug (*Pseudococcus bakeri* Essig) under bark of the English walnut. (Essig, P. C. Jr. Ent.)

Distribution.—So far it has been found only in Ventura County at Santa Paula and Oxnard.

Food Plants.—Walnut, apple, pear and lemon. Works under the bark and in crevices upon the tender cambium layer.

Control.—Same as for the citrus mealy bug.

CITRUS OR GREENHOUSE MEALY BUG.

Pseudococcus citri (Risso).

(Figs. 78-84.)

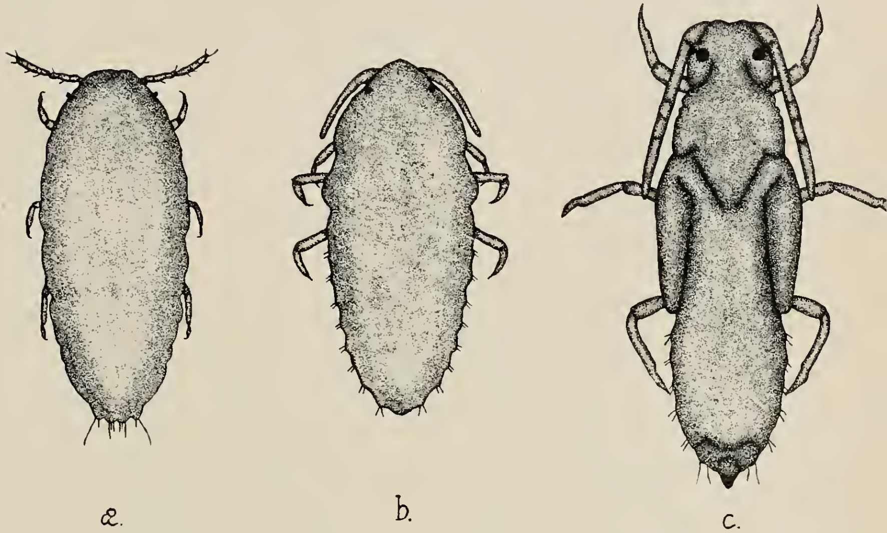

FIG. 78.—Immature stages of the male citrus mealy bug. a, young just hatched from egg; b, young after cocoon is finished; c, nearly matured. (Essig, P. C. Jr. Ent.)

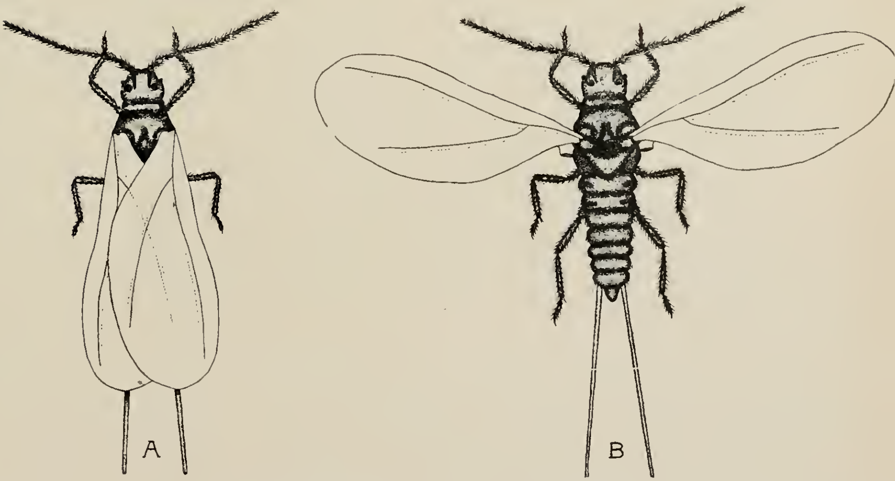

FIG. 79.—Adult males of citrus mealy bug. A, with wings folded in normal attitude; B, wings spread. (Essig, P. C. Jr. Ent.)

General Appearance.—Small mealy-coated soft-bodied insects, from one fourth to three eighths inches long and two thirds as wide. They are specially characterized by a large amount of white waxy secretion covering the bodies. There are no perceptible wax tails or appendages.

Life History.—The eggs are deposited in loose cottony masses by the females upon the food plants, mostly during the late fall and winter months, though some may be laid in summer. The young upon hatching move about very freely seeking suitable feeding places upon the tender foliage or young fruit. The females continue to move at will throughout their existence, but the young males soon spin a small white cocoon (Fig. 81) in which to pupate. Transformation requires but a short time, the two-winged males (Fig. 79) emerging when the females are about half grown. After copulation the males die and the females continue to develop for some weeks or months before egg-laying begins.

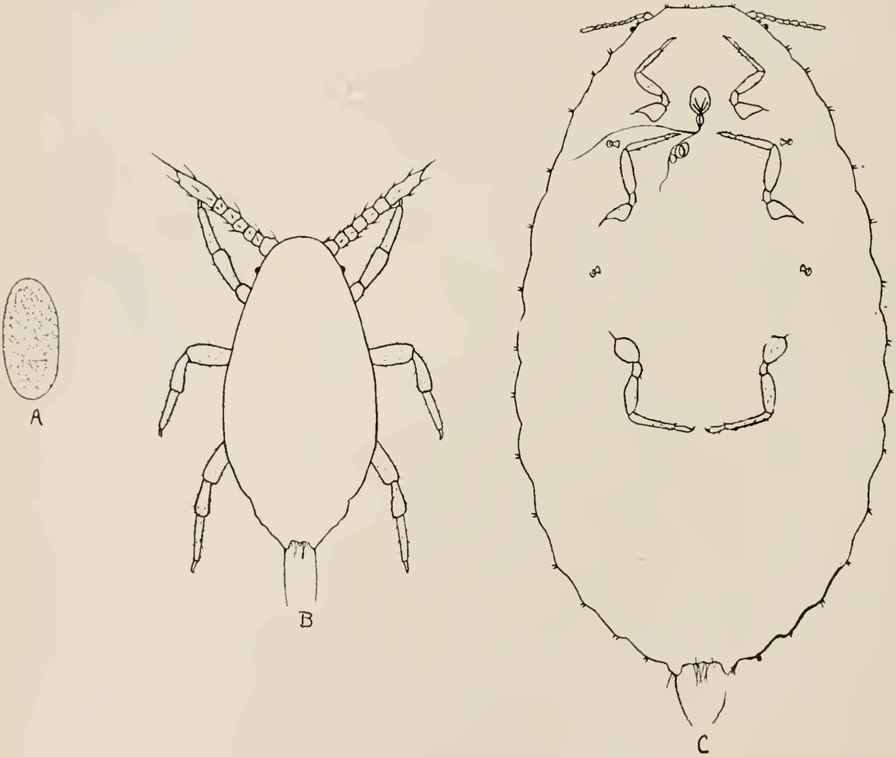

Fig. 80.—Drawings showing development of the female citrus mealy bug. A, egg; B, young before first moult; C, adult with cottony covering removed to show body. (Essig, P. C. Jr. Ent.)

During the spring months the young are to be found in great numbers, but by summer they have so hidden themselves as to give the general impression that the pest leaves the trees during that period. In the fall the adults begin to deposit the large masses of eggs which make them more conspicuous. The entire strength of the female is converted into eggs, only the shriveled and dry skin remaining after all have been deposited.

The insect naturally hibernates during the winter in the egg state, but due to the uneven hatching caused by the warm weather in the southern part of the State, practically all stages of the young and the adult males and females may be also abundant during the winter months.

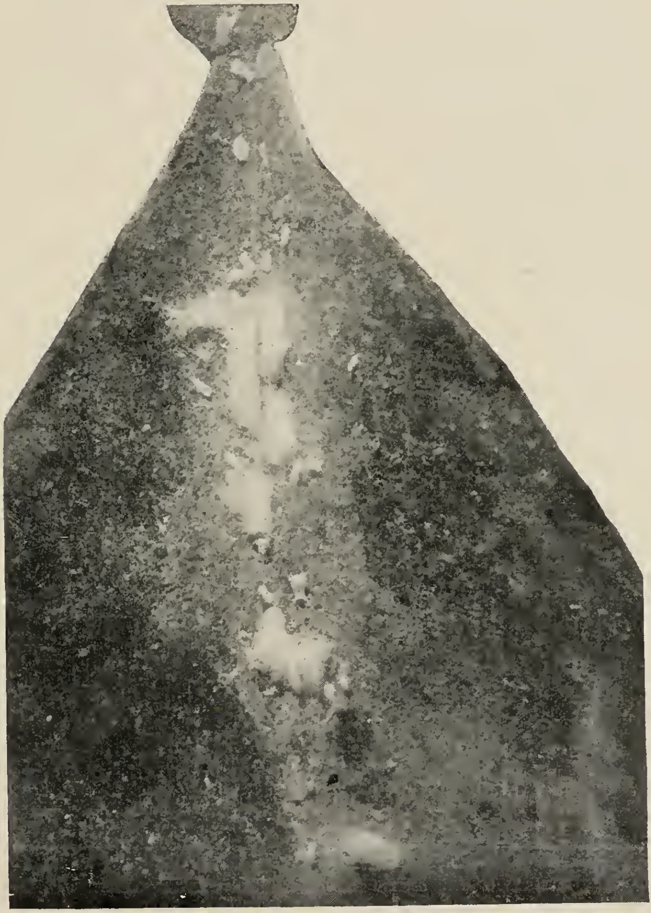

FIG. 81.—Cocoons of the male mealy bugs. Immature females also visible. (Essig, P. C. Jr. Ent.)

Distribution.—Throughout the entire State. Present in nearly all the citrus sections, excepting in the counties of the warmer interior regions.

Food Plants.—Works on a great variety of plants, including begonia, *Bignonia* sp., *Bouvardia* sp., *Callistemon lanceolatus*, *Ceanothus integerrimus*, *Citrus aurantium*, *Citrus limonum*, *Citrus decumana*, *Citrus medica*, *Coleus* sp., *Cucurbita pepo*, *Cyperus alternifolius*, *Erythea edulis*, *Euphorbia pulcherrima*, *Filicales*, *Fuchsia* sp., *Nerium*, *Pæonia* sp., *Passiflora violacea*, *Strelitzia regina*, *S. gigantea*, *Solanum douglasii*, *Tradescantia multicolor*, *Nicotiana tabacum*, *Coffea arabica*, *Gossypium* sp., *Hedera helix*, *Ipomœa* sp., *Solanum jasminoides* and *Habrothamnus* sp. The fruit as well as all tender growing parts of the plant are attacked.

Control.—The control of this pest has been somewhat complicated and unsatisfactory, although at the present time considerable or complete success attends the efforts of careful work. Without doubt the best control measure is the application of a carbolic acid emulsion spray, which should be applied plentifully, from ten to fifteen gallons to an average size tree, and under a pressure of two hundred pounds.

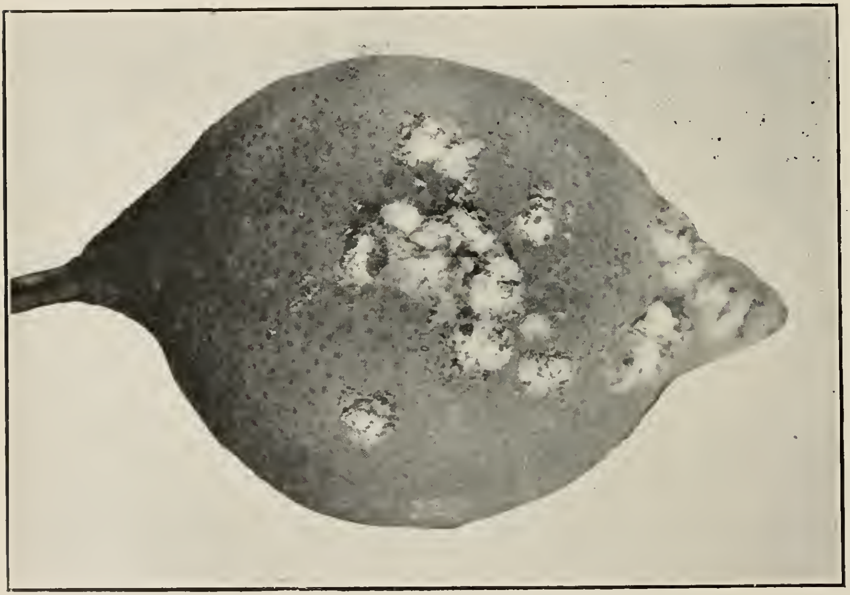

FIG. 82.—Egg masses of the citrus mealy bug on lemon. (Essig, P. C. Jr. Ent.)

We have found that two angle "Bean Jumbo" nozzles on a "Y" to each rod give best results. Large-holded discs should be used in the nozzles to insure a coarse driving spray.

If the mealy bug is present in great numbers it may be necessary to make two, three or even four applications a week or so apart.

During the winter, when there are large numbers of egg-masses, or in the spring when the young are hatching, is the best time for applying the sprays.

Fumigation has often given excellent killing results, but is not at all recommended for this pest, unless some other destructive scale insect, such as red, yellow, black or purple scale, is present and needs that treatment. Experience has shown that an excessive dose gives little better result than the ordinary black-scale dosage (one half to three fourths of Schedule No. 1).

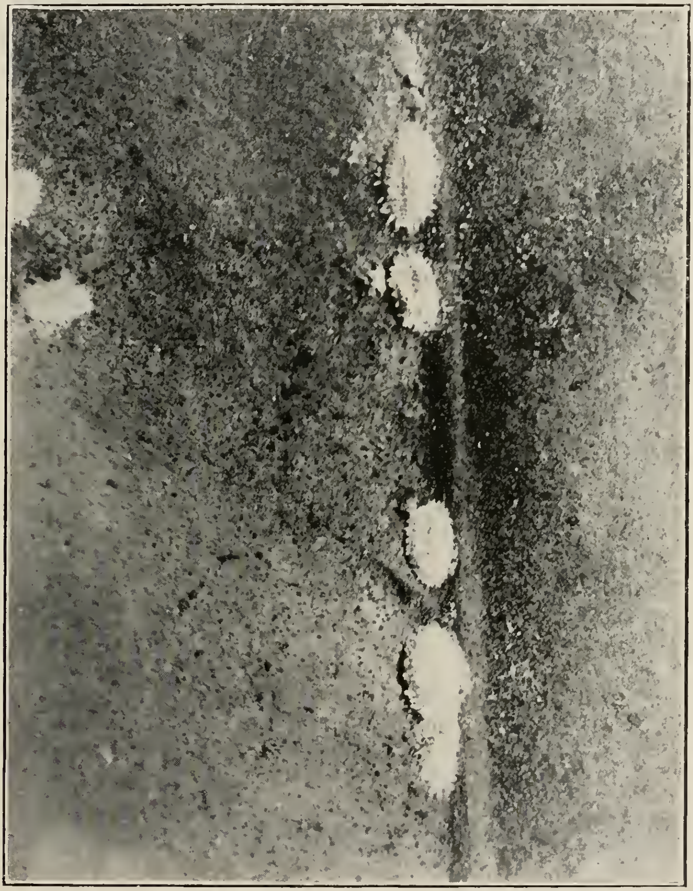

FIG. 83.—Adult females of the citrus mealy bug on a lemon leaf. (Essig, P. C. Jr. Ent.)

Natural Enemies.—The ladybird beetle, *Cryptolæmus montrouzieri*, is the most important natural check, though the following insects prey upon this pest: the ladybird beetles, *Rhizobius ventralis*, *Lindorus lopanthæ*, *Scymnus guttulatus*, *S. sordidus*, *S. marginicollis*, *Cryptogonus orbiculus*, *Hyperaspis lateralis*; the green lacewing, *Chrysopa californica* Coq.; the brown lacewing, *Sympherobius angustus* Bks.: the hymenopterous parasites, *Chrysoplatycerus splendens* How., *Cheiloneurus dactylopii* How. and the dipterous parasite, *Leucopis bella* Loew.

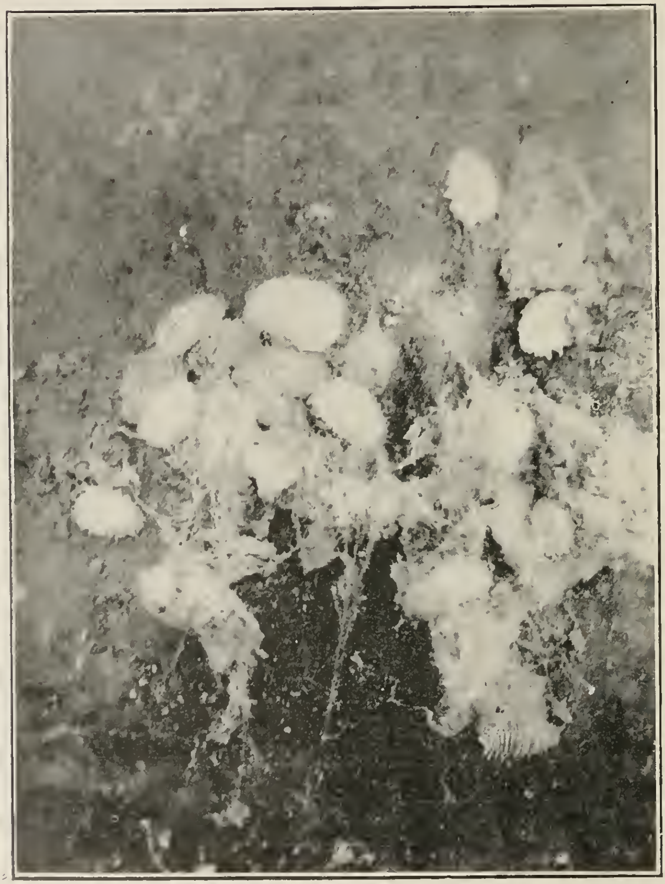

FIG. 84.—Adult females and egg masses of the citrus mealy bug (*Pseudococcus citri*) on orange. (Essig, P. C. Jr. Ent.)

THE WHITE SAGE MEALY BUG.

Pseudococcus crawii (Coq.).

(Fig. 85.)

General Appearance.—The same as *P. citri*, but with anal appendages conspicuous, being less than half as long as the body. The male is blackish-brown.

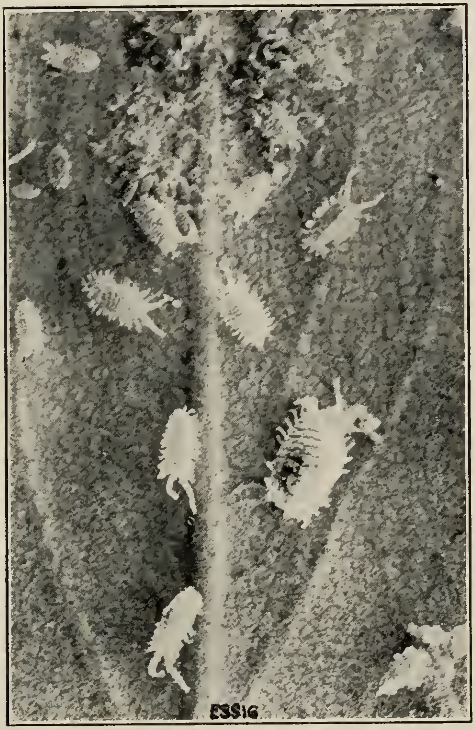

FIG. 85.—The white sage mealy bug, *Pseudococcus crawii* (Coq.). (Original.)

Life History.—The young are brought forth alive in great numbers. The females usually settle on the leaves, which are slightly curled to afford protection. This species is most abundant during the months of May, June and July, and is rarely found at other times.

Distribution.—Throughout the white sage belt of Southern California.

Food Plant.—White sage (*Ramona polystachya*). The foliage is attacked, causing the leaves to curl.

Natural Enemy. — This insect is usually held in check by a native ladybird beetle (*Scymnus mœrens*).

THE LONG-TAILED MEALY BUG.

Pseudococcus longispinus (Targ.).

(*Pseudococcus adonidum* Linn.)

(Fig. 86.)

General Appearance.—The same as the citrus mealy bug in size, shape and color, but is readily distinguished from it by the long white anal appendages as long, or longer, than the body, from which it gets its name.

Life History.—No eggs are laid by this species, the young being born alive. Several generations appear each year, in fact in the southern part of the State the breeding extends throughout practically the entire year. The life cycle occupies about two months.

Distribution.—Occurs generally throughout the State, but is particularly bad in greenhouses and ornamental gardens.

Food Plants.—Is especially destructive to *Dracæna* sps., but also occurs on moonvine, citrus, coleus, sago palm (*Cycas revoluta*), ferns, oleander, plum, staghorn fern (*Platycerium*), *Cyperus alernifolius*, mango, guava, fig, croton, *Flacourtia sepiaria*, *Nephrodium*, *Stangeria schizodon*, *Zamia* sp.

Control.—The same as for the citrus mealy bug.

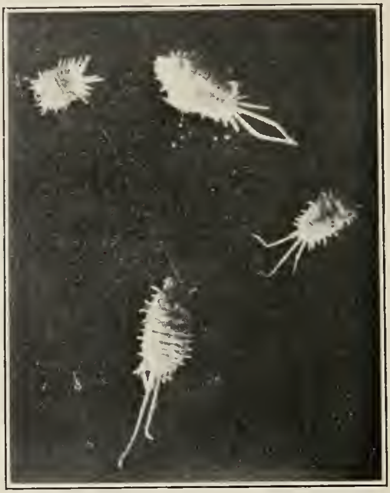

Fig. 86.—The long-tailed mealy bug (*Pseudococcus longispinus* Targ.). (Essig. Bull. 1, C. Pom. Cl.)

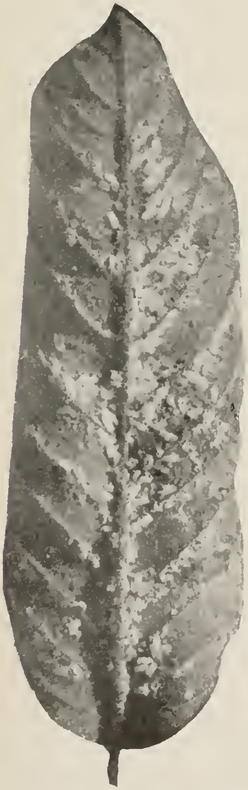

Fig. 87.—The guava mealy bug (*Pseudococcus nipæ* Mask.) on guava leaf. (Essig, P. C., Jr. Ent.)

THE GUAVA MEALY BUG.

Pseudococcus nipæ (Mask.).

(Fig. 87.)

General Appearance.—Greatly resembles the diplacus ceroputo (*Ceroputo yuccæ*), but somewhat smaller and the covering is slightly cream-colored.

Life History.—Same as other members of this family. The male cocoons are stiff-walled and very numerous, being cylindrical in shape.

Distribution.—Taken in quarantine. It is especially abundant in Mexico and Hawaii Territory, and is included here because of the probability of its being located within the State at any time.

Food Plants.—Destructive to guavas, infesting all parts of the plants. Also works on palms, *Nipa fruticans*.

Control.—Same as for the citrus mealy bug (*Pseudococcus citri*).

THE KENTIA MEALY BUG.

Pseudococcus pseudonipæ (Ckll.).

(Fig. 88.)

General Appearance.—This species is readily distinguished from the other mealy bugs by the cream colored flocculence or wax which is not smoothed over the body but arranged on the segments in rows of small columns or patches and by the seven-jointed antennæ. The bodies are rich amber which lends the creamy color to the flocculence. The males are pale yellow.

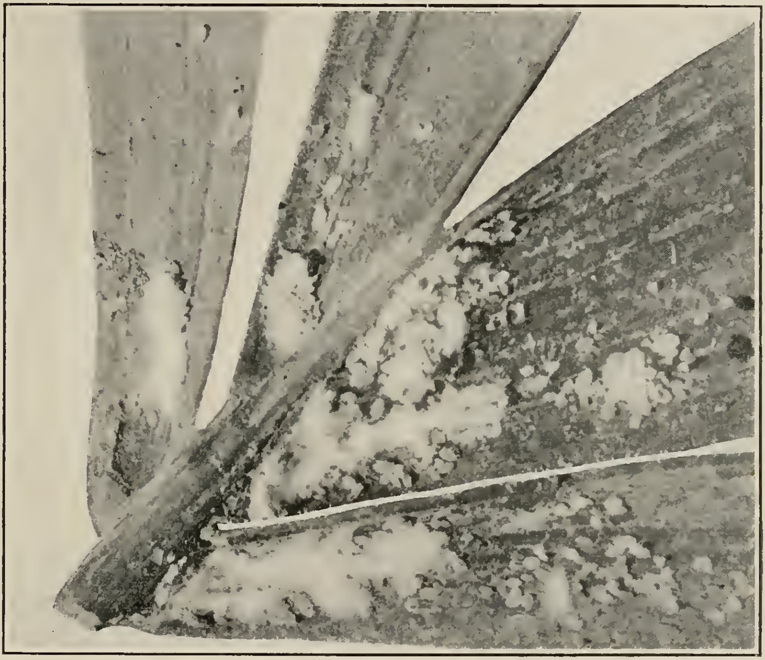

FIG. 88.—The Kentia mealy bug, *Pseudococcus pseudonipæ* (Ckll.) on the under side of palm leaf. Natural size. (Original.)

Distribution.—Occurs in greenhouses in many parts of the State and sometimes in the open in the southern sections.

Food Plants.—This insect is often quite a pest, doing much damage to tender palms of the species *Kentia* and *Cocos*. It collects in great colonies upon the under sides of the leaves, as shown in Figure 88, and produces smutting and so weakens the plants as to make them unfit for sale or use.

THE WILD RYE RIPERSIA.

Ripersia smithii Essig.

(Fig. 89.)

General Appearance.—This insect resembles the common mealy bug, but is much more slender and has a very fine cottony covering. It differs from most of the true mealy bugs by having but seven articled antennæ.

Life History.—The eggs are deposited in loose cottony masses beneath the female or behind her within the culm of the infested grass. They are small, elliptical in form and yellow in color. The young greatly resemble the females, being light or pink in color. Lenth 4 to 6 mm. Males have not been taken. The females enter the grass stems through holes bored by other insects.

Distribution.—Taken only in Ventura County.

Food Plant.—This insect works on the tender shoots and between the blades and culms of the common wild rye (*Elymus condensatus*).

Natural Enemy.—Held in check by the larvæ of a small native ladybird beetle belonging to the genus *Scymnus*.

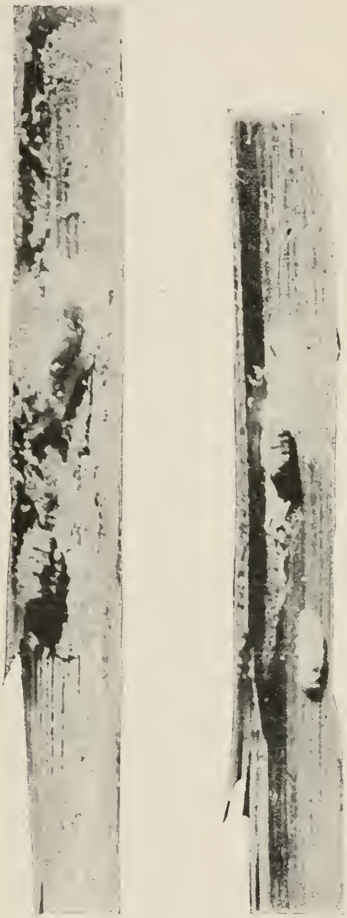

FIG. 89.—The wild rye ripersia (*Ripersia smithii* Essig) within the plant stems. (Essig, P. C. Jr. Ent.)

THE COTTONY BAMBOO SCALE.

Antonina crawi Ckll.

(Fig. 90.)

General Appearance.—The full-grown female scales are completely covered with a thick, compact white, cottony coat, which makes them very conspicuous. The body proper varies from one eighth to nearly one fourth of an inch long; broadly oval or rounded and deep purplish-red in color. The white coating may be nearly one half inch in diameter. The females collect in colonies forming large cottony masses in the leaf-axils of the canes.

Distribution.—This insect has often been taken in quarantine. It now occurs in many greenhouses and gardens, where bamboo is grown and is confined to the central and southern parts of the State. The writer collected large quantities of it in a private garden in Ventura.

Food Plant.—It works upon the bamboo where it collects in large colonies in the crotches and leaf-axils of the canes and is especially damaging to young growths.

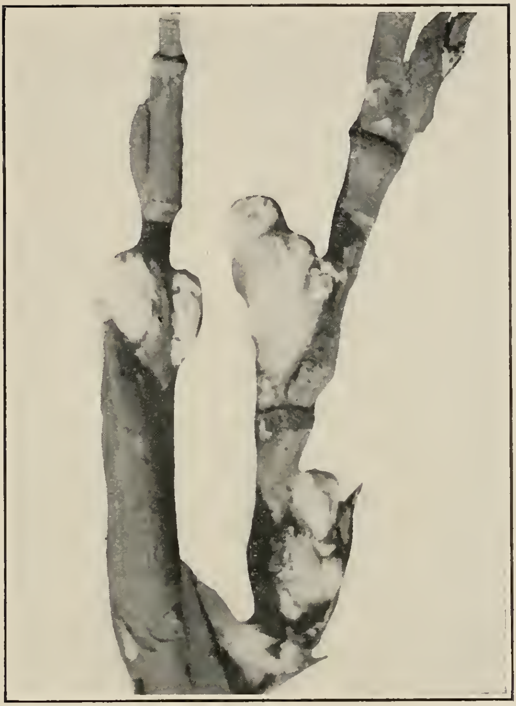

Fig. 90.—The cottony bamboo scale, *Antonina crawi* Ckll. (Original.)

Control.—Due to the thick cottony covering it is exceedingly difficult to kill the adults, but frequent spraying with emulsions or soap solutions will eliminate the young as fast as they appear.

COCCINÆ (Subfamily).

The members of this subfamily may be grouped as follows: Those having soft, naked bodies and retaining power of locomotion, such as the soft brown scale; those having naked oval bodies with hard chitinous coat, with power of locomotion only in the young stages, such as black and hemispherical scales; and those being naked with waxy secretions behind or around them, with oval or flat bodies and having power of locomotion only in the young stages, such as wax and cottony maple scales.

THE FRUIT-TREE PULVINARIA.

Pulvinaria amygdali Ckll.

(Fig. 91.)

General Appearance.—The general appearance of this insect is well shown in Figure 91. The body proper is yellowish to brownish and the large egg-sac white. The entire length, including egg-sac, is nearly one half inch.

Distribution.—The distribution of this scale is exceedingly limited, being so far reported only from Los Angeles and Tehama counties. It was collected in Los Angeles County by C. H. Vary and in Tehama County by Chas. B. Weeks. However, it may be met with in any part of the State, especially in the central and southern sections.

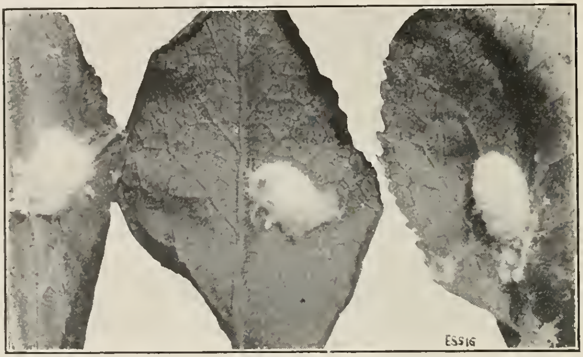

FIG. 91.—The fruit-tree pulvinaria (*Pulvianaria amygdali* Ckll.). Natural size. (Original.)

Food Plants.—The specimens taken by Mr. Vary and Mr. Weeks were feeding upon the foliage of the prune. The scale also attacks peach trees.

COTTONY MAPLE SCALE.

Pulvinaria vitis (Linn.).

(*Pulvinaria innumerabilis* Rathv.)

(Fig. 92.)

General Appearance.—This species can be easily recognized in early summer by the large white cottony egg-sacs which are posterior to the brown female bodies.

Life History.—The eggs are very small, oval, and white to yellow in color. They are deposited in the large, loose, cottony sacs, which are secreted by the females. The young first settle on the leaves and later move to the limbs. The males appear late in the fall to mate and die. In the spring the females increase very rapidly and after egg-laying shrivel and die. There is but one generation a year.

Distribution.—Not at all extensive and of no economic importance in this State.

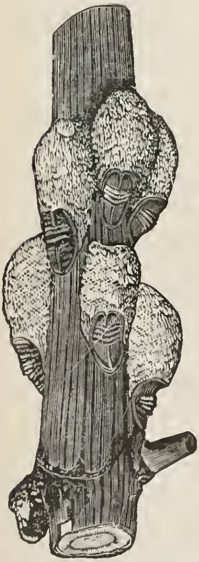

FIG. 92.—The cottony maple scale, *Pulvinaria vitis* (Linn.) (After Comstock.)

Food Plants.—Maple, pear, apple, plum, peach, grape, sumach, linden, sycamore, locust, beech, elm, oak, orange, box-elder, spindle-tree, mulberry, alder, hawthorn, lilac, blackberry, willow, *Æsculus flava, Aralia japonica, Viburnum dentatum.*

Control.—Kerosene and carbolic acid emulsions, or resin wash, applied when the young are hatching will aid in reducing the coming broods.

Natural Enemies.—There are many natural enemies, including *Rhizobius ventralis, Coccophagus lecanii* and *Encyrtus flavus,* which prey upon this coccid.

THE JAPANESE OR MEXICAN WAX SCALE.

Ceroplastes ceriferus (Anderson).

(Fig. 93.)

General Appearance.—The adults look like lumps of dough stuck to the branches. The body proper is black and about the size of a garden pea, with a prominent posterior tubercle or pygidium. The waxy covering is very thick, making the diameter of the scale from one fourth to three fourths of an inch. The color of the protecting coat varies from white to cream. Fig. 93.

Life History.—Practically the same as *Ceroplastes floridensis.*

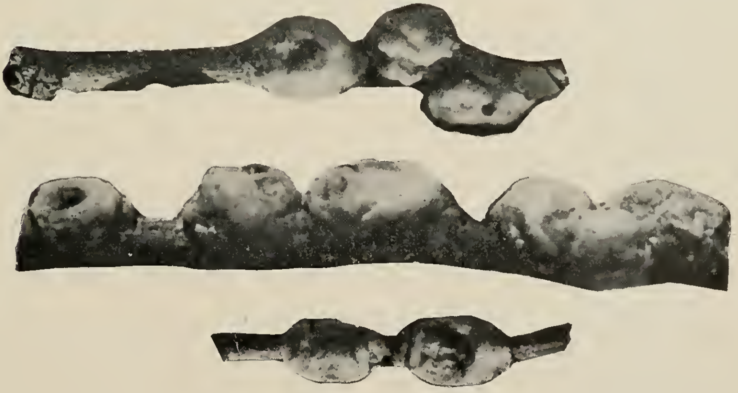

Fig. 93.—The Japanese or Mexican wax scale, *Ceroplastes ceriferus* (Anderson). (Essig, P. C. Jr. Ent.)

Distribution.—In greenhouses, and taken in quarantine from Japan, Mexico, India, Australia, Ceylon, Hawaiian Islands and South America.

Food Plants.—*Hibiscus, Camellia, Gardenia, Myrica cerifera,* tea, mango and orange.

Control.—The same as given under *Ceroplastes floridensis.*

THE BARNACLE SCALE.

Ceroplastes cirripediformis Comst.

(Fig. 94.)

General Appearance.—This wax scale greatly resembles the Florida wax scale in shape. The body is dark red or brown, and the white waxy covering is mottled with shades of gray. There is a spine-like projection at the posterior end of the body, which is hid by the wax. The length is one fifth of an inch; width one sixth of an inch; height the same as the width. This species is larger and particularly higher than the Florida wax scale.

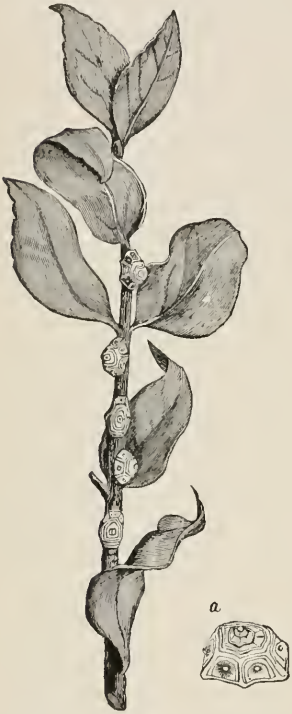

FIG. 94.—The barnacle scale, *Ceroplastes cirripediformis* Comst. (After Comstock.)

Life History. — Eggs reddish brown, darker than those of the *Ceroplastes floridensis.* Young are dark brown in color. The development and work are practically the same as that of *Ceroplastes floridensis.*

Distribution.—Principally in greenhouses in the central and southern part of the State.

Food Plants.—Citrus trees, quince, *Eupatorium,* myrtle, persimmon, Solanum, *Lignum vitæ.*

Control.—The same as for *C. floridensis.*

THE FLORIDA WAX OR WHITE SCALE.

Ceroplastes floridensis Comst.

(Fig. 95.)

General Appearance.—White or pinkish waxy scales, oval in form, convex above and concave beneath, from one twelfth to one eighth of an inch in diameter. The upper surface is evenly and beautifully lobed, as shown in Fig. 95. The body is red and seen through the white wax gives the pinkish color.

Life History.—The eggs, one hundredth of an inch long, are dark red and vary from seventy-five to one hundred to each female. The young hatch beneath the scale and soon after leaving settle to feed, first upon the leaves, and then upon the stems and smaller branches. The wax shell forms with the growth of the females. There are from three to four broods a year, covering a period from April to November.

Distribution.—Very limited in hothouses.

Food Plants.—Citrus trees, quince, apple, pear, fig, guava, Japan plum (*Biotrites japonica*), myrtle, ferns, oleander, mango, red bay, *Lignum vitæ*, pomegranate, tea, *Ilex glabra*, *Anona reticulata*, *Andromeda*, *Anthurium*.

Control.—It is seldom that this insect becomes so numerous as to be destructive, but this has occurred. Spraying should be done before the waxy covering is formed. Resin wash or kerosene emulsion is recommended.

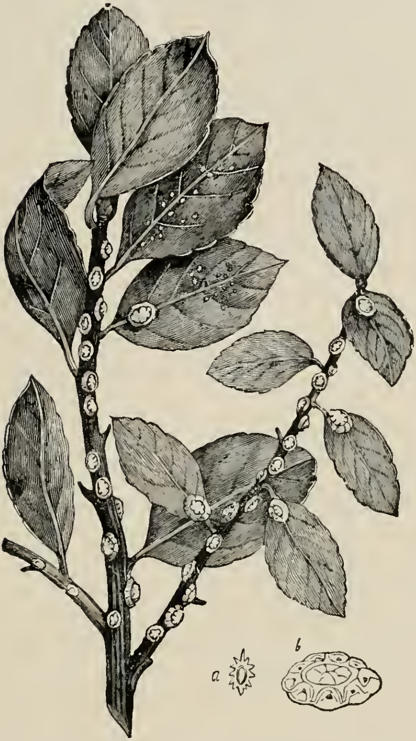

Fig. 95.—The Florida wax or white scale, *Ceroplastes floridensis* Comst. (After Comstock.)

THE PALM SCALE.

Eucalymnatus perforatus (Newst.).

(Fig. 96.)

General Appearance.—A large flat, soft scale resembling the soft brown scale (*Coccus hesperidum*), but much darker and more irregular in outline. The surface is covered with yellowish or greenish mosaic markings.

Life History.—Resembles much that of *Coccus hesperidum*, but is usually confined to green- and lath-houses; however, not a serious pest.

Distribution.—Throughout the central and southern part of the State.

Food Plants.—Kentia and other palms, *Caryota cumingii*, *Eugenia jambos*, *Howea belmoreana*, *Trachycarpus excelsus*.

Control.—Spraying with carbolic acid, kerosene or distillate emulsions. In treating tender greenhouse plants these sprays should be diluted considerably to prevent injury.

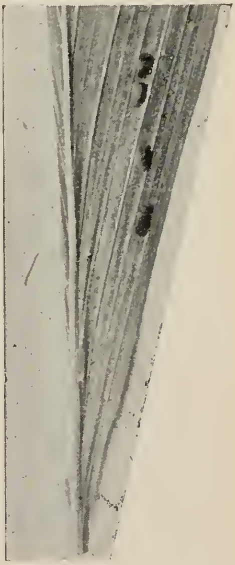

Fig. 96.—The palm scale, *Eucalymnatus perforatus* (Newst.). (After Craw.)

THE SOFT BROWN SCALE.

Coccus hesperidum (Linn.).

(Fig. 97.)

General Appearance.—Oval, flat, soft scale, varying from straw to dark brown color; often with distinct darker markings. The largest attain one fourth of an inch or over in length and three fourths as much in width.

Life History.—The young are born alive in great numbers. The male scales are many times smaller than the females and much lighter in color. All stages are bark and leaf feeders. On citrus trees they crowd in such numbers as to overlap on the younger limbs and the midribs of the leaves. The life cycle covers from three to five months.

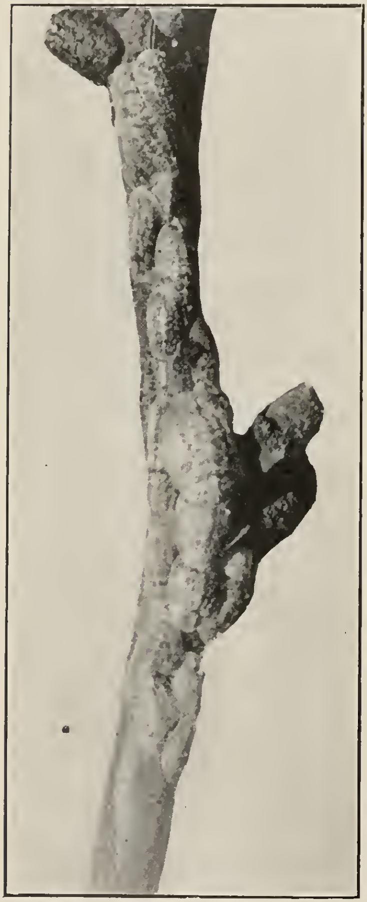

FIG. 97.—Soft brown scale (*Coccus hesperidum* Linn.) on orange twig. (Essig, P. C. Jr. Ent.)

Distribution.—Throughout the entire State. A serious pest to many plants and very troublesome in greenhouses.

Food Plants. — Citrus, oleander, camellia, clematis, morning-glory, holly, ivy, laurel, box elder, myrtle, jasmine, mulberry, *Cycas revoluta*, india rubber, *Phlox*, California laurel (*Umbellularia californiaca*). It does much damage to young citrus trees and at Pomona is seriously attacking the old trees. The work is confined to the stems and foliage.

Control.—Same as for black scale.

Natural Enemies.—The internal parasites, *Aphycus flavus*, *Encyrtus flavus*, *Coccophagus lecanii*, *Coccophagus lunulatus*, contribute to hold this pest in check but remedial measures are nearly always necessary wherever it appears.

THE CHERRY SCALE.

Eulecanium cerasorum (Ckll.).
(Fig. 98.)

General Appearance.—The full-grown scales are exceedingly large, often obtaining a height of three eighths of an inch, though the average is slightly over a quarter of an inch. The general shape is hemispherical, and the bodies are very irregular and lobed. The general color is rich brown, mottled with creamy white. The markings are more or less regular and constant. The entire surface is highly polished and shiny.

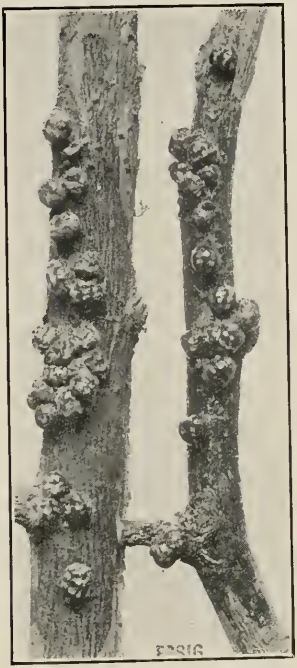

Fig. 98.—The cherry scale, *Eulecanium cerasorum* (Ckll.), on pear. Slightly reduced. (Original.)

Distribution.—In the bay region, especially in Contra Costa County.

Food Plants.—This scale works upon the branches of cherry and pear trees, collecting in such great numbers as to do considerable damage.

Control.—Same as for black scale on deciduous fruit trees or for the European fruit scale.

THE FROSTED SCALE.

Eulecanium pruinosum (Coq.).
(Figs. 99, 100.)

General Appearance.—This is one of the largest unarmored scales, often one half an inch long, and three fourths as wide. The full grown scales are nearly hemispherical in shape (Fig. 99), while the young and

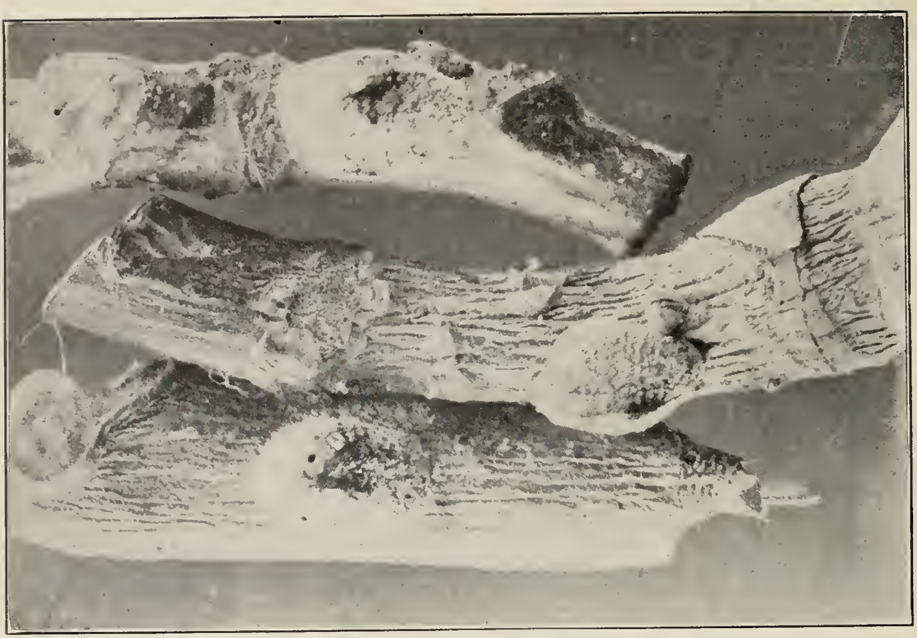

Fig. 99.—Frosted scale, *Eulecanium pruinosum* (Coq.). Mature scales on walnut. (Essig, P. C. Jr. Ent.)

half-grown forms are very flat (Fig. 100). The surface is covered with white frost-like wax, which readily distinguishes it from all other common species.

Life History.—Eggs are white to yellowish in color and are deposited in the early summer months. The species is not as prolific as many of the others of this genus, and because of parasites scarcely does any damage.

Distribution. — Throughout the central and southern parts of the State.

Food Plants. — Apricot, prune, peach, plum, cherry, pear, apple, walnut, laurel, ash, birch, sycamore, cork-elm, grape, rose, orange, loganberry and hawthorn. The branches are usually the parts attacked.

Control.—Same as for European fruit scale (*Lecanium corni*)

Natural Enemies. — *Comys fusca* and at least two other internal parasites were bred from this species, and keep it in complete subjection.

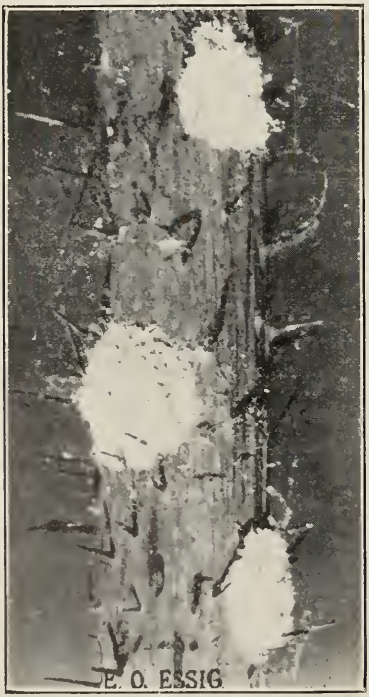

Fig. 100.—Immature specimens of the frosted scale on loganberry cane. (Original.)

THE HEMISPHERICAL SCALE.

Saissetia hemisphærica (Targ.).

(Fig. 101.)

General Appearance.—This species is not quite as large as the black scale. Regular and oval in shape with polished surface and rich brown color without markings.

Life History.—The eggs are very minute and vary from pearly-white to cream color. The life history is practically the same as that of *Saissetia oleæ*. On citrus trees the scales are often found around the margins of the leaves, but on other plants the stems and foliage are attacked. Not a serious pest.

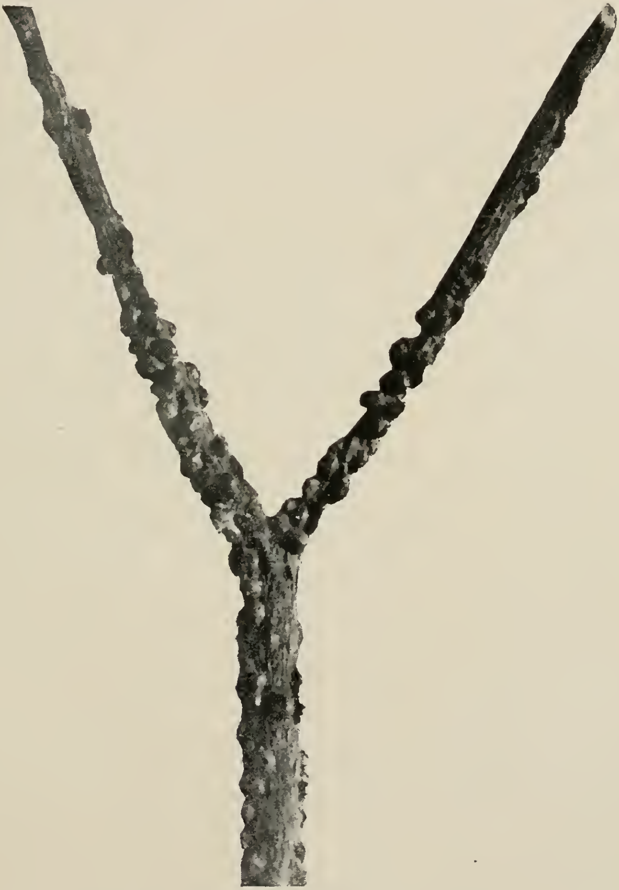

FIG. 101.—Hemispherical scale, *Saissetia hemisphærica* (Targ.), on bignonia. (Essig, P. C. Jr. Ent.)

Distribution.—A general greenhouse scale throughout the State. In Southern California it is quite common, especially in parks and ornamental gardens.

Food Plants.—Citrus, palm, orchid, camellia, guava, chrysanthemum, asparagus fern, bignonia, oleander, peach, sago palm, *Zamia* sp., ferns. Works upon the foliage and stems, but is occasionally found upon citrus fruits.

Control.—Same as for black scale (*Saissetia oleæ*).

Natural Enemies.—The black ladybird beetle, *Rhizobius ventralis*, the egg parasite, *Scutellista cyanea*, and the internal parasites, *Comys fusca* and *Coccophagus lecanii*, aid greatly in keeping down the numbers of this insect.

THE BLACK SCALE.

Saissetia oleæ (Bern.).

(Fig. 102.)

General Appearance.—Black, oval, tough-skinned scales with a distinct "H" on the back of half- and full-grown females. From one eighth to one fourth of an inch in diameter. The young vary from

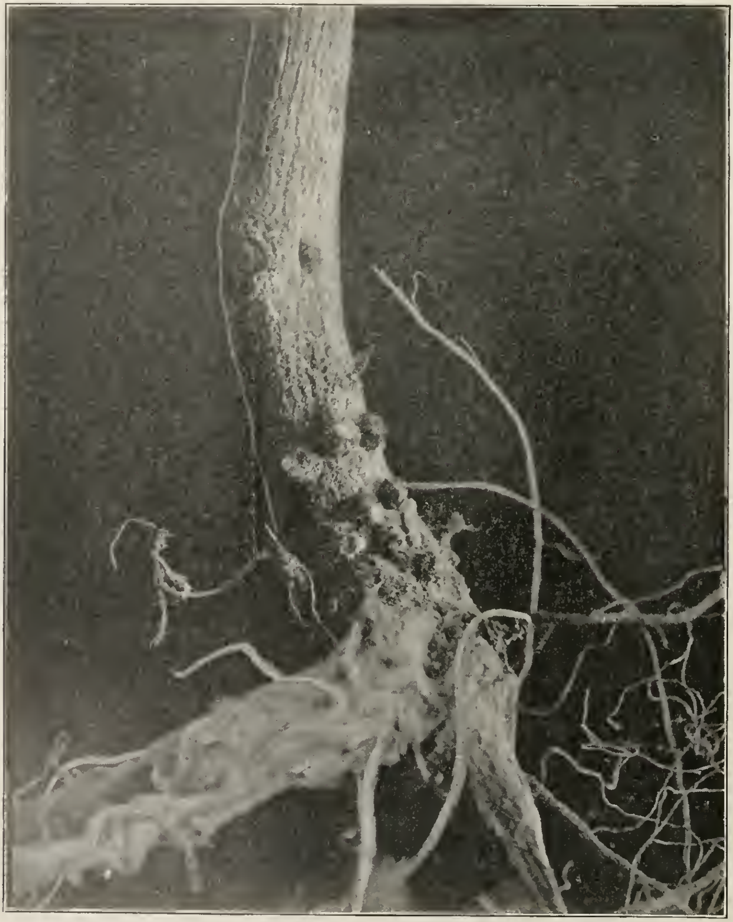

Fig. 102.—Full grown specimens of black scale, *Saissetia oleæ* (Bern.), at base of nightshade plant. Many of these were under the surface of the soil. (Essig, P. C. Jr. Ent.)

light yellow to brown. The males are very minute and scarcely ever seen. The eggs are nearly globular and slightly amber in color.

Life History.—The females deposit from fifty to three hundred eggs, covering a period of from two to four weeks. The most are laid during the months of May, June and first half of July, though in some sections all stages of the insect may be found. Young half-grown scales are most abundant from September 15th to December 15th and the full-grown females from February 15th to July 15th. They work principally upon the leaves of the trees, when they are young, but later are found almost wholly on the limbs.

Distribution.—Occurs throughout the entire State and is particularly abundant and destructive in the citrus growing sections of the southern part along the coast, and may well be termed the worst of citrus insect pests.

Food Plants.—All citrus trees; olive, apricot, guava, honey locust, Irish juniper, pomegranate, Lombardy poplar, apple, prune, plum, almond, pear, sycamore, oleander, pepper (*Schinus molle*), sumach, (*Rhus*), mountain holly or Christmas berry (*Heteromeles arbutifolia*), *Baccharis viminea*, rubber tree, *Habrothamnus*, *Myoporum*, *Melaleuca*, laurel, holly, beech, ash, buckthorn, maple, *Grevillea*, *Ligustrum*, nightshade, *Antidesma*, *Duranta*, *Grewia*, *Thespesia*, *Cajanus*, magnolia, eucalyptus, grape, camellia, phlox, watermelon and asters.

Control.—Fumigation: On citrus trees fumigate with from one half to three fourths schedule No. 1, between September 1st and January 1st. If the hatch is very even and the work can be done early, the one half schedule is sufficient, but for ordinary work three fourths of the schedule is required.

Sprays: On deciduous fruit and olive trees the following sprays may be used when the scales are not more than half-grown: Water distillate caustic soda mechanical mixture and distillate emulsion.

Natural Enemies.—The ladybird beetles, *Rhizobius ventralis*, steel blue (*Orcus chalybeus*), *Olla plagiata* and *Axion plagiatus* work on the young scales; the parasites, *Scutellista cyanea* and *Tomocera californica* Haw., on the eggs and the internal parasite, *Aphycus flavus* How., on the male scale.

THE EUROPEAN FRUIT SCALE.

Lecanium corni Bouché.

(*Eulecanium armeniacum* Craw.)

(Fig. 103.)

General Appearance.—Similar to that of the soft brown scale (*Coccus hesperidum*) but the adult forms are much more oval and of a more reddish and darker color.

Life History.—Great quantities of very small eggs are laid under the scale of each female. The young reach maturity in from three to six weeks and usually settle on the smaller limbs of deciduous fruit trees.

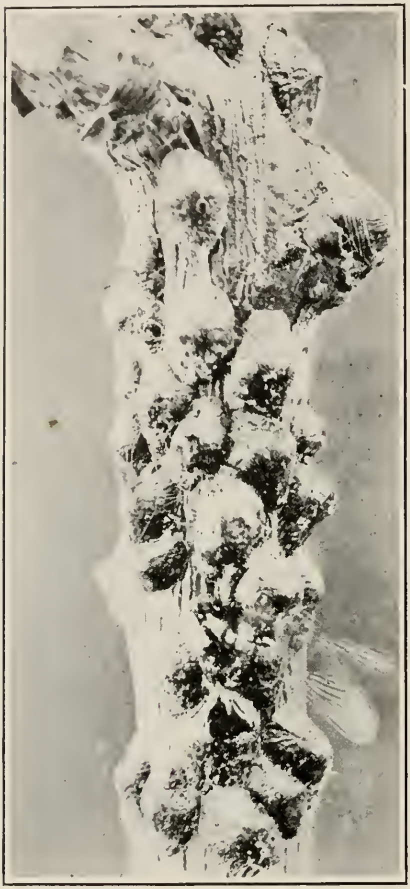

FIG. 103.—The European fruit scale (*Lecanium corni* Bouché) on branch of apricot. (Essig, Bull. 2, Vent. Co. Hort. Com.)

Distribution.—Throughout the entire State.

Food Plants. — Prune, apple, apricot, plum, cherry, peach, pear, grape, gooseberry and Spanish chestnut. The limbs and young twigs are attacked.

Control.—Spraying with caustic soda distillate water mechanical mixture or distillate emulsion, when the trees are dormant, as early as possible, gives excellent results. In many cases it is advisable to spray before all the leaves fall.

Natural Enemies.—The internal parasite, *Comys fusca*, is the most efficient natural check. It is given credit of completely controlling this pest in many localities.

DIASPINÆ (Subfamily).

The females of this family are all characterized by the formation of a scale which affords complete protection for the body underneath. They are termed armored scales and are very small and exceedingly variable in shape. Representatives of this family are abundant in every section and comprise some of the most destructive and difficult pests to control known. The San José scale, purple scale, red scale and rose scale are examples.

THE ORANGE CHIONASPIS.

Chionaspis citri Comst.

(Fig. 104.)

General Appearance.—The female scales are elongated, blackish-brown in color, with gray margins and dark yellow exuviæ. The male scales are very small, long and narrow, white with exuviæ yellow. They are often grouped so thickly as to almost hide the females and make the branches appear white.

Life History.—Practically the same as that of *C. euonymi.*

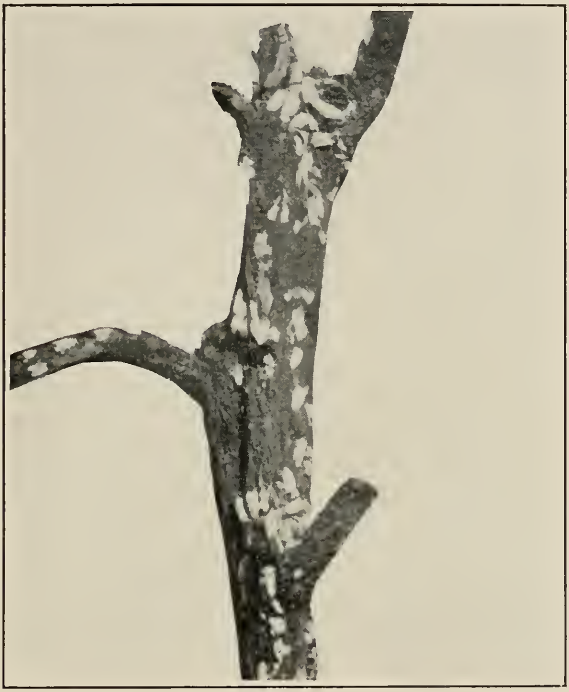

FIG. 104.—The orange chionaspis, *Chionaspis citri* Comst. (Original.)

Distribution.—Though this scale has often been taken in quarantine, it has become established only in San Diego County, and there to a very slight degree.

Food Plants.—Its favorite food plant is the orange, though other species of citrus trees are attacked as well as holly (*Osmanthus ilicifolius*), palms and *Euonymus* sps.

Control.—Fumigation as for red or purple scales will easily control this pest.

THE EUONYMUS SCALE.

Chionaspis euonymi Comstock.

(Fig. 105.)

General Appearance.—The female scale is dirty brown with yellow exuviæ, convex and broader posteriorly. The scale of the male is snow-white, long and narrow, slightly shorter than the diameter of the female scale, which is from 1.75 to 2 mm. and strongly tricarinated.

Life History.—The young insects are yellow and soon settle to produce the scales of the male and female. So thick are they that plants and entire hedges are ruined by the sapping of the females, while the same may appear to be covered with fine flakes of snow due to the great numbers of minute white scales of the males. The insects attack all parts of the host and are very destructive.

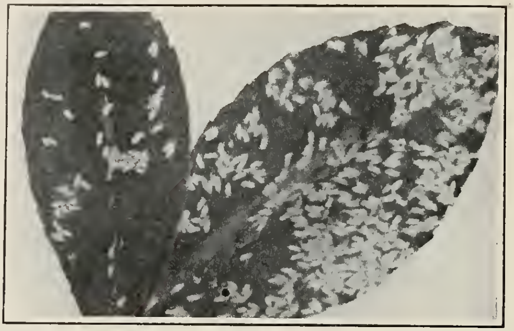

Fig. 105.—The euonymus scale, *Chionaspis euonymi* Comst. (After Sanders.)

Distribution.—In greenhouses and taken in quarantine.

Food Plants.—*Euonymus latifolius, E. japonicus, E. europæus, E. atropurpureus, Celastrus scandens*, orange.

Control.—Spray with kerosene or distillate emulsion or resin wash every two weeks between the months of May and June or until the scale has disappeared. The spraying should be done during the hatching period. Care should be taken to see that the sprays are not strong enough to injure the foliage.

In the winter when the plants are dormant much stronger solutions of the same sprays may be used with lasting effects.

THE SCURFY SCALE.

Chionaspis furfura (Fitch).

(Fig. 106.)

General Appearance.—The female scale is irregular and broadly pear-shaped; from white to light gray in color. The exuviæ is yellowish and from one eighth to one tenth of an inch in length. The male scale is white, very small, long, tricarinated and with yellow exuviæ at the pointed end.

Life History.—The winter is passed by the females under the scales where the purple or wine-colored eggs are laid and hatch in the spring shortly after blooming time. The young begin at once to cover their bodies with a scale.

This insect is sometimes confused with the oyster shell scale, but is broader and much lighter in color, having dark red eggs, while those of the oyster shell scale are yellowish-white.

Distribution.—Limited, but present in the State on apples.

Food Plants.—This species attacks many plants, chief of which are apple, pear, plum, cherry, quince, Japanese quince, currant, mountain ash, hawthorn, peach, poplar, gooseberry, crab-apple, chokecherry, black walnut and elm.

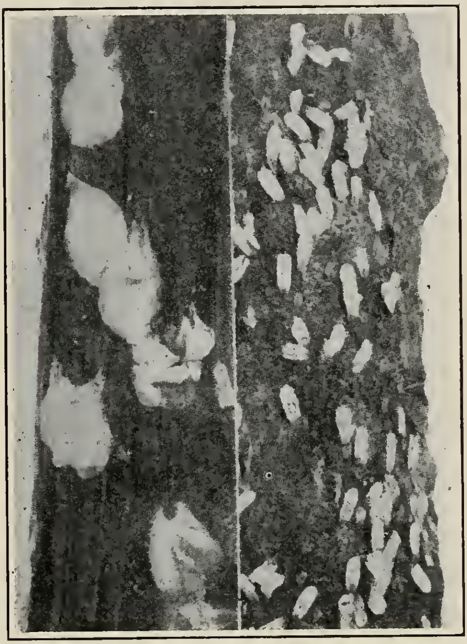

Fig. 106.—The scurfy scale, *Chionaspis furfura* (Fitch). Adult females at left and males at right. (After Quaintance and Sasscer.)

Control.—Same as for San José scale.

THE PINEAPPLE SCALE.

Diaspis bromeliæ (Kern.).

(Fig 107.)

General Appearance.—The outer shells or scales of the females are thin, circular and nearly pure white in color, with exuviæ yellow. The bodies proper are yellow or orange, sometimes with blue or purple tints.

Life History.—The females usually attack the leaves into which they burrow and may become almost entirely hidden under the epidermis. The fruit is also infested.

Distribution.—Occurs in greenhouses and often taken in quarantine.

Food Plants.—Pineapple, *Bromelia pinguin, Hibiscus,* canna, ivy, *Billbergia zebrina, Olea fragrans.*

Control.—Spraying when the pest occurs in the field with kerosene emulsion and resin wash offers effectual control.

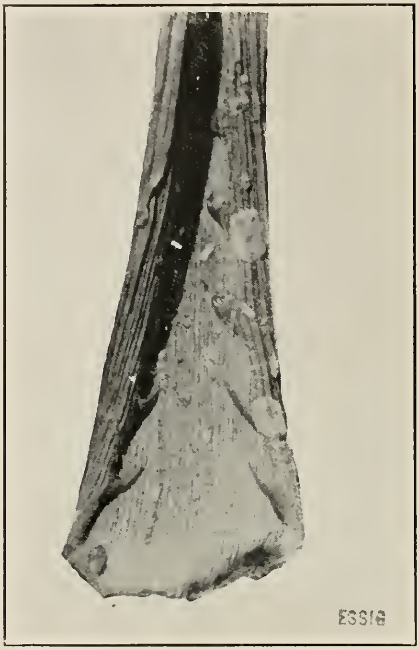

Fig. 107.—The pineapple scale, *Diaspis bromeliæ* (Kern.). (Original.)

Natural Enemies.—*Aspidiotiphagus citrinus* has been bred from this species.

THE WEST INDIAN OR WHITE PEACH SCALE.

Aulacaspis pentagona (Targ.).

General Appearance.—The scale of the adult female is circular with exuviæ near one side, and gray in color. The male scales are elongate, white, and with distinct rib down the middle. They are longer than the diameter of the female scale.

Life History.—The life history of this scale greatly resembles that of the rose scale (*Aulacaspis rosa*). There are three broods a year.

Distribution.—So far this coccid has not been a serious pest though it has been known to exist in this State since 1888. It occurs in the central and southern parts.

Food Plants.—Peach, mulberry, plum, prune, apricot, walnut, geranium, cherry, pear, *Guaguma ulmifolia, Cycas media, C. circinalis,* *Capsicum* (pepper), grape, persimmon, heliotrope, cotton, laurel, willows, *Argyreia specciosa, Bryophyllum calycinum, Pelargonium, Jasminum, Zizyphus, Tylophora asthmatica, Calotropis procera, Hibiscus esculentus, Acanthus, Sedum, Zamia mexicana, Callacarpa lanata, Ricinus communis.*

Control.—Same as for San José scale.

Natural Enemies.—The two-stabbed ladybird beetle, *Chilocorus bivulnerus,* feeds upon this scale.

THE ROSE SCALE.

Aulacaspis rosæ (Bouché).

(Fig. 108.)

General Appearance.—The female scales are nearly circular with very irregular edges and white to gray in color with reddish body. The diameter varies from one sixteenth to one eighth of an inch. The male scales are long and narrow, very minute, with three longitudinal creases, or carinæ, and the bodies reddish white.

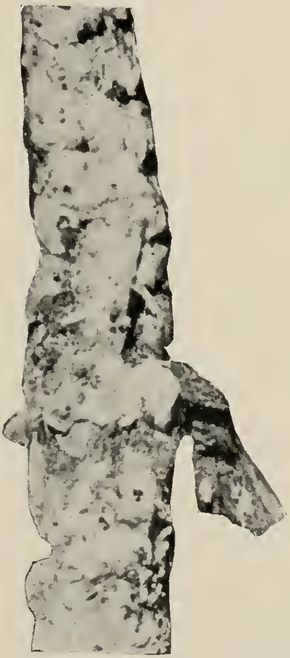

FIG. 108.—The rose scale, *Aulacaspis rosæ* (Bouche), on blackberry. (Essig. P. C. Jr. Ent.)

Life History.—All stages of this scale occur practically throughout the entire year, including the eggs, and its spread is very rapid. The females cluster in great numbers on the canes of berries and roses, especially around the crown of the roots. It is especially abundant during the spring and summer months. It attacks wild and cultivated plants.

Distribution.—Through the entire State and common in the southern and central parts.

Food Plants.—Blackberries, raspberries and roses. Abundant on wild blackberries in the Sacramento Valley.

Control.—As the eggs are present at practically all seasons and are hard to kill, by either spraying or fumigation, this is a somewhat difficult scale to control. The worst infected canes should be cut out and burned and the remaining sprayed successively with kerosene, distillate or carbolic acid emulsion, or with lime-sulphur when the plants are dormant in the winter.

THE PEAR SCALE.

Epidiaspis piricola (Del Guercio).

General Appearance.—The female scale is circular or oval with first exuviæ dark brown and in the center. The color is dark gray with glossy finish. The male scales are readily distinguished by their small, pure white, elongated shells, with single median longitudinal carina. They are much flattened posteriorly. The larval skin is brown or yellow.

Life History.—This species resembles the San José scale in its habits and is often mistaken for it.

Distribution.—In the Santa Clara Valley.

Food Plants.—Pear, plum, apple, peach and currant.

Control.—Lime-sulphur spray (1-9) when the trees are dormant is a good remedy. The crude oil emulsion is also highly remommended for this scale.

THE GREEDY SCALE.

Aspidiotus camelliæ Sign.
(*Aspidiotus rapax* Comst.)
(Fig. 109.)

General Appearance.—This scale greatly resembles the San José scale, but is somewhat lighter in color, larger, much more convex, being noticeably high and with exuviæ near one side. The shell is thin showing the yellow body beneath.

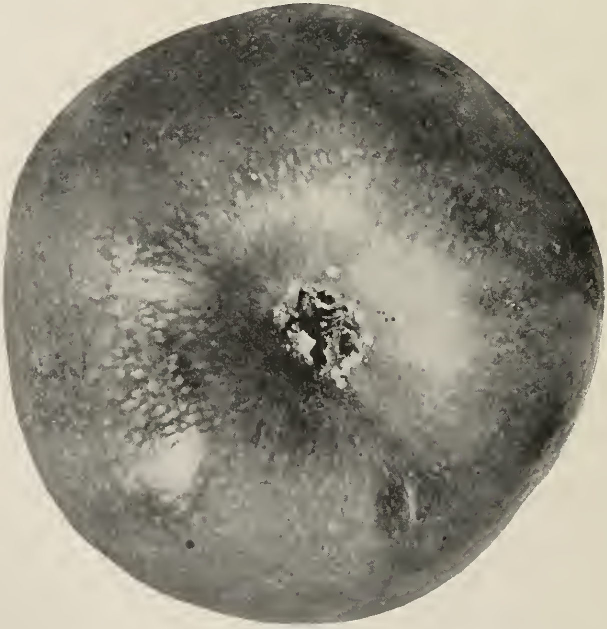

Fig. 109.—Greedy scale (*Aspidiotus camelliæ* Sign.) around calyx of apple. (Cal. Hort. Com.)

Distribution.—One of the commonest scale insects and found in wild as well as cultivated areas throughout the State.

Food Plants.—This species attacks a very large list of plants, though it has never yet become a serious pest to any horticultural or agricultural product. The food plants reported in California are *Acacia*, *Baccharis pilularis*, camellia, camphor, *Ceanothus*, *Cercis* sp., *Cissus* sps., quince, *Dioscorea*, sp., *Erica* sp., eucalyptus, euonymus, fuchsia, English ivy, mountain holly, walnut, *Lavatera* sp., umbrella tree, myrtle, olive, passion vine, mistletoe, pittosporum, cottonwood, almond, cherry, pomegranate, pear, apple, rose, willow, *Salvia* sp., *Sedum* sp., nightshade, *Strelitzia* sps., California bay or pepperwood and grape.

Natural Enemies.—An undetermined internal parasite has been bred from this species.

IVY OR OLEANDER SCALE.

Aspidiotus hederæ (Vall.).

(Figs. 110, 111.)

General Appearance.—Circular flat scale, one sixteenth to one eighth of an inch in diameter, the male scales being very much smaller. The color varies from light to dark gray. On lemons this species often appears quite red and is occasionally taken for red scale (*Chrysomphalus aurantii*), but the lack of the small, central dark exuviæ together with its smooth, flat surface makes it easily distinguishable from red scale and also from the greedy scale (*Aspidiotus camelliæ*), which is decidedly pointed.

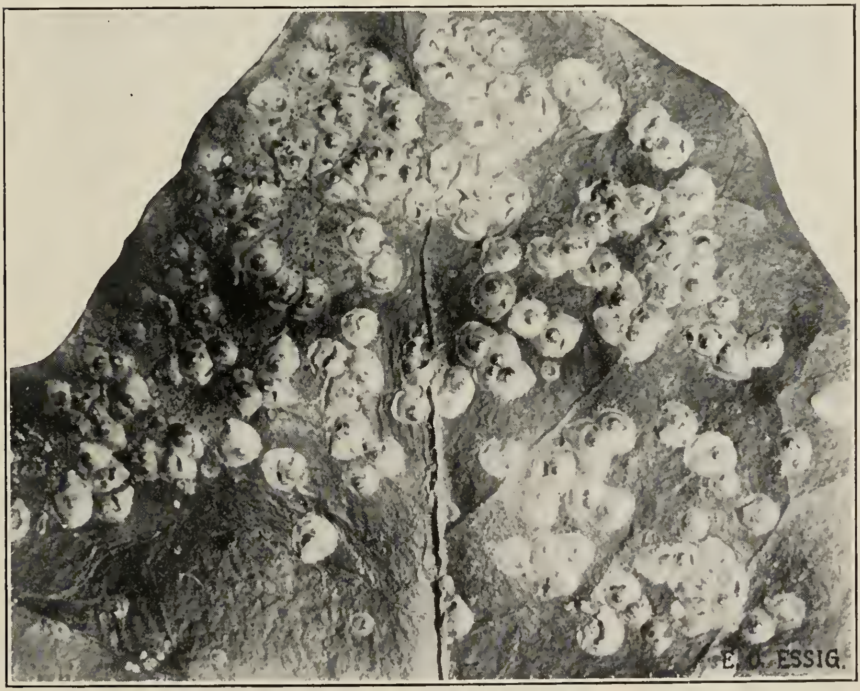

Fig. 110.—The ivy scale (*Aspidiotus hederæ* Vall.) on English ivy leaf. (Original.)

Life History.—Same as the other species of this genus of which the San José scale is given as typical. This species is cosmopolitan and is everywhere throughout the State. It is a greenhouse pest and often causes alarm to citrus growers by appearing on the fruit, but we find it attacks only old "tree ripes." It is perhaps most serious in many of the olive orchards in the Sacramento Valley, where it infests the fruits so as to make them unfit for pickling purposes.

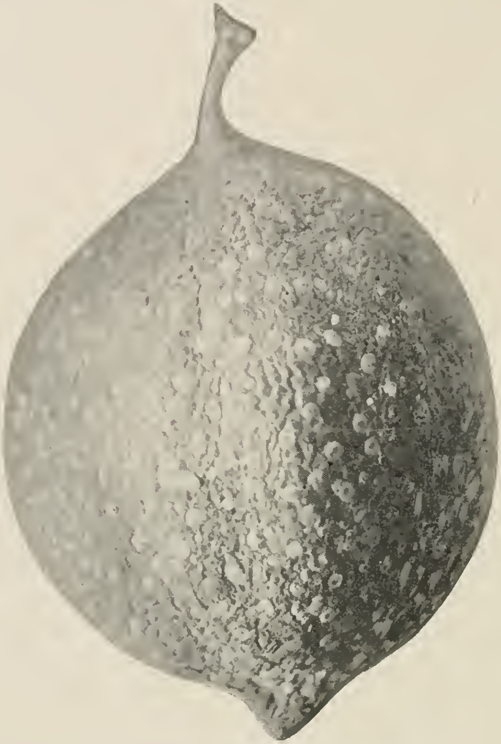

Fig. 111.—*Aspidiotus hederæ* (Vall.) on lemon and in such cases known as the lemon peel scale. (Essig, P. C. Jr. Ent.)

Distribution.—Throughout the entire State and country.

Food Plants.—Ivy, oleander, holly, boxwood, orange and other citrus species, olive, plum, cherry, currant, maple, camellia, grass, clover, yucca, asparagus fern, pepper tree, *Ruscus aculeatus*, *Ceratonia*, *Cercis*, *Erica*, *Rubia peregrina*, *Genista*, *Daphne gnidium*, *Quercus ilex*, *Aloe umbellata*, *Agave palmeri*, *Acacia* sps., *Cycas revoluta*, *Myrsine retusa*, *Vriesia splendens*, *Carpodetus serratus*, *Vitex littoralis*, ferns (*Filicales*), maidenhair fern, *Cyperus alternifolius*, *Eucalyptus* sps., fan palm (*Latania borbonica*), magnolia, umbrella tree (*Melia azedarach*), mulberry, *Opuntia littoralis*, *Phœnix dactylifera*, mistletoe, *Pinus radiata*, pomegranate, buckthorn, sumach, redwood (*Sequoia sempervirens*), nightshade, California laurel (*Umbellularia californica*).

Control.—Same as for San José scale.

Natural Enemy.—A small chalcid parasite works effectively upon this scale.

THE ENGLISH WALNUT SCALE.

Aspidiotus juglans-regiæ Comst.

(Fig. 112.)

General Appearance.—Scales grayish to brownish, circular with exuviæ near one side. The position of the first skin is marked by a pink or reddish brown prominence. Body is yellow; diameter of shell one sixteenth of an inch. The male scale is elongated, the same color as the female, and one third as large.

Life History.—The young settle on the tender shoots or tough bark on the trunks and limbs. The adults secrete themselves so closely to the bark as to be almost hidden. In many cases they appear to mine into it.

Distribution. — Throughout the southern part of the State in limited numbers, but has never become a serious pest. Taken by the writer in Ventura County, but found only on cottonwood trees there.

Food Plants.—English walnut, cottonwood, locust, pear and cherry.

Control.—Lime sulphur (1-9) during the winter months will easily control this scale.

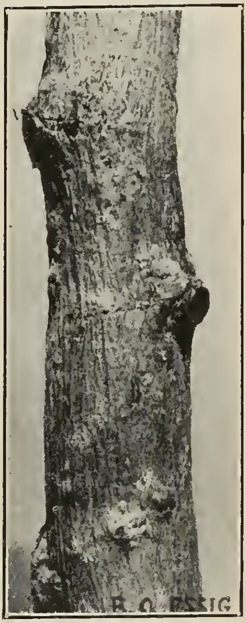

FIG. 112.—English walnut scale (*Aspidiotus juglans-regiæ* Comst.). (Original.)

THE PERNICIOUS OR SAN JOSE SCALE.

Aspidiotus perniciosus Comst.

(Figs. 113, 114.)

General Appearance.—The female scales are circular, light gray and less than one eighth of an inch in diameter. The body is yellow. The male scale is much smaller than the female, somewhat longer, and of the same color. The males are very delicate pink insects with two frail wings.

Distribution.—Occurs in every part of the entire State and has become a very common pest.

Food Plants.—Practically all of the deciduous fruit trees are attacked, as well as shrubs, ornamentals, etc. The following food plants are recorded in California: quince, walnut, almond, cherry, plum, prune, peach, pear, apple, sand pear, currant, rose, raspberry, hawthorn, privet, poplar, willow, osage orange, elm.

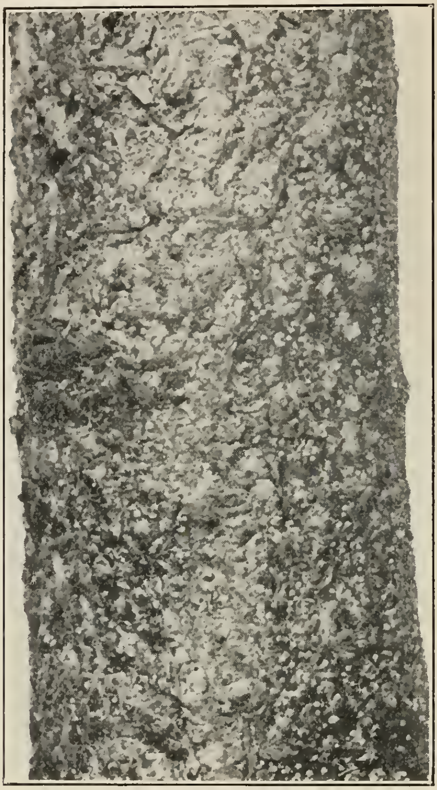

Fig. 113.—The pernicious or San José scale on peach twig. (After Quaintance.)

Control.—The application of commercial lime-sulphur spray (1 to 9 or 1 to 11 of water) during the dormant season in the winter. The lime-sulphur should be applied as a driving spray at a pressure of from 150 to 200 pounds, care being taken to thoroughly cover every portion of the tree.

Natural Enemies.—The internal parasites, *Aphelinus fuscipennis, Aphelinus mytilaspidis, Aspidiotiphagus citrinus* and the predaceous ladybird beetles, *Chilocorus bivulnerus, Lindorus lopanthæ, Orcus chalybeus,* prey upon this scale very effectively.

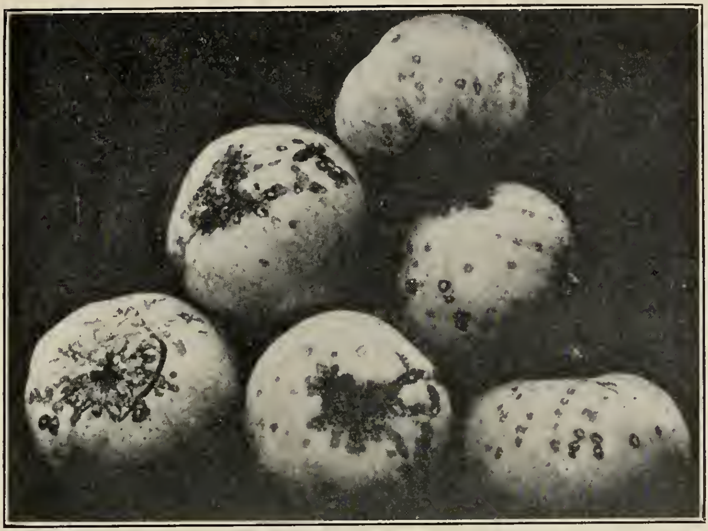

Fig. 114.—Apples infested with pernicious scale (*Aspidiotus perniciosus* Comst.). (After Britton.)

THE FLORIDA RED OR CIRCULAR SCALE.

Chrysomphalus aonidum (Linn.).

(*Chrysomphalus ficus* Ashm.)

(Fig. 115.)

General Appearance.—The scales are characterized by their exceedingly regular and circular shapes, shining dark brown surface and median circular exuviæ. They are slightly larger, more regular, and darker than the common red orange scale (*Chrysomphalus aurantii*).

Distribution.—Though this species is troublesome in the southern Gulf States as an outdoor pest, its attacks in California are almost entirely confined to greenhouses in the central and northern parts and to subtropical ornamental gardens in the southern part of the State. It is not an orchard pest.

Food Plants.—The favorite food plants of this species are palms and rubber trees. Other plants attacked are *Araucaria bidwillii, Aspi-*

distra lurida, camellia, *Citrus* sps., oleander, camphor, cocoanut, begonia, guava and banana.

Control.—Same as for the red or orange scale.

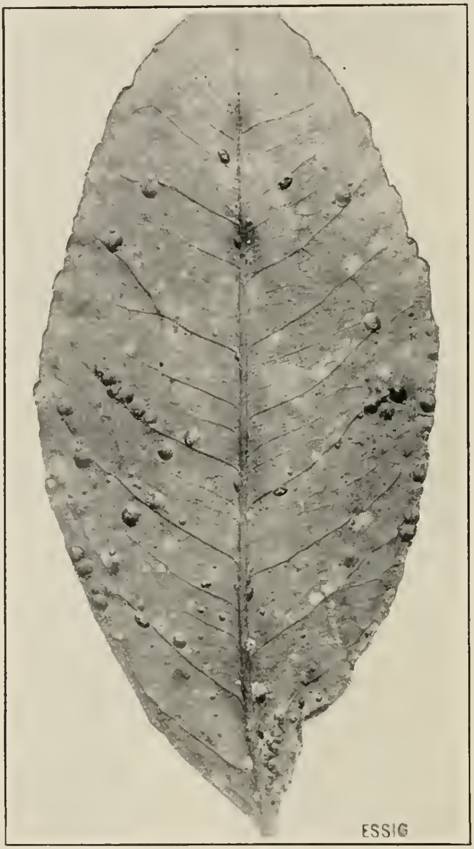

Fig. 115.—Florida red or circular scale, *Chrysomphalus aonidum* (Linn.), on orange leaf. (Original.)

THE RED OR ORANGE SCALE.

Chrysomphalus aurantii (Mask.).

(Figs. 116, 117.)

General Appearance.—Distinctly circular and flat, the female scales varying from one sixteenth to one eighth of an inch in diameter. The scale or shell is transparent, allowing the red female body, which gives it a distinctly red color, to show through. The male scales are elongated, very much smaller and gray or dark brown in color.

Life History.—The young are born alive in great numbers. They are usually produced during the warm summer months from June to September, but in the milder sections may continue to appear much longer. Like other coccids the males are winged and so small as to be scarcely observed. The females settle on the trunks, limbs, foliage and fruit, and cause great damage. Trees may be entirely killed by their attacks. It is one of the most serious pests known to citrus fruit culture.

Distribution.—Throughout the southern citrus belt, and particularly bad in sections of San Diego, Orange, Los Angeles, Riverside, San Bernardino and Santa Barbara counties.

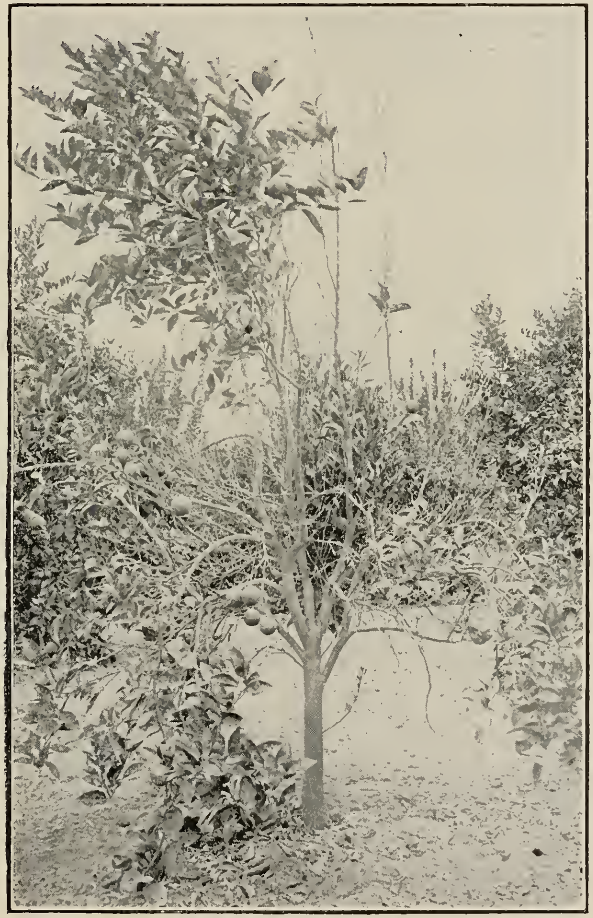

FIG. 116.—Large portion of orange tree killed by two years' infestation of red scale, *Chrysomphalus aurantii* (Mask.). (After Quayle, Courtesy Cal. Exp. Station.)

Food Plants.—All citrus trees, camphor, fig, olive, rose, pear, plum, apple, quince, willow, oak, grape, acacia, tea plant, wattle, sago palm, nightshade, English walnut, Eucalyptus, passion vine, date palm, California fan palm, *Podocarpus,* golden rod, *Ligustrum, Artocarpus, Bidens, Kennedya, Euonymus,* lignum-vitæ, fuchsia, box elder, agave, cocoanut, and pistacia.

Control.—Fumigation with full schedule No. 1. Spraying is only efficacious on deciduous fruit trees with lime-sulphur (1-9), caustic soda distillate water mechanical mixture or distillate emulsion.

Natural Enemies.—The ladybird beetles, steel-blue (*Orcus chalybeus* Boisd.), *Lindorus lopanthæ* Blaisd., the two-stabbed (*Chilocorus bivulnerus* Mul.), *Scymnus marginicollis* Mann., *Scymnus nebulosus* Lec., *Hippodamia convergens* Guer., *Hippodamia ambigua* Lec., *Coccinella californica* Mann.; the green lacewing (*Chrysopa californica* Coq.); the brown lacewing (*Sympherobius angustus* Bks.); some of the members of the hemipterous family *Reduviidæ;* the internal parasites, *Prospaltella aurantii* How., *Coccophagus lunulatus* How., *Aspidiotiphagus citrinus* Craw., *Signiphora occidentalis* How., *Aphycus immaculatus* How., *Alaptus eriococci* Girault, *Physcus flaviventris* How., all prey upon this pest.

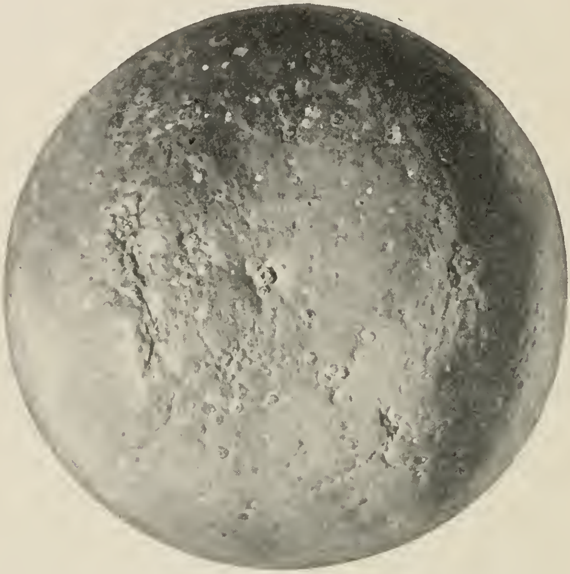

FIG. 117.—Red scale, *Chrysomphalus aurantii* (Mask.), on orange. (Essig, P. C. Jr. Ent.)

THE YELLOW OR CITRUS SCALE.

Chrysomphalus citrinus (Coq.).

(Fig. 118.)

General Appearance.—Flat, circular scales resembling the red scale (*Chrysomphalus aurantii*) in shape and size, but are decidedly yellow in color.

Life History.—Practically the same as red scale, the chief difference being in the feeding habits: the red scale usually attacks the trunks, small limbs, leaves and fruit, while the yellow scale attacks all but the trunks and small limbs. Some county commissioners consider this more serious than red scale on citrus trees. While this may be true in some sections, yet as a general citrus pest it cannot be compared with red scale, especially in the coast counties.

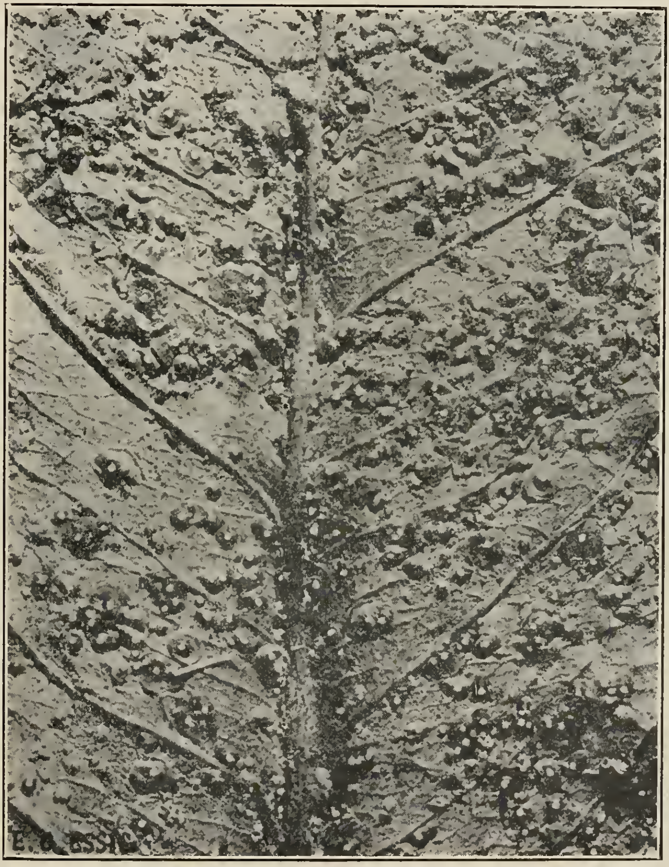

FIG. 118.—Yellow or citrus scale, *Chrysomphalus citrinus* (Coq.), on orange leaf. (Original.)

Distribution.—Throughout the entire citrus growing sections of the State, and especially abundant in the interior valleys.

Food Plants.—Citrus trees, *Euonymus*, *Aucuba* and *Ficus* sps.

Control.—The same as for red scale.

Natural Enemies.—The predaceous insects are the same as those working upon red scale, *Aspidiotiphagus citrinus* Craw, is the most effective internal parasite.

Chrysomphalus rossi (Mask.).

(*Aspidiotus rossi* Mask.)

(Fig. 119.)

General Appearance.—The scale of the adult female is circular or irregularly oblong with ragged margins; flattened; reddish to dark brown, with inner surface around and including exuviæ almost black. The male scale is smaller and lighter in color. The female body is reddish yellow and about 1.5 mm. long. The eggs are light purple and hatch soon after being laid. The first hatched larvæ are pink.

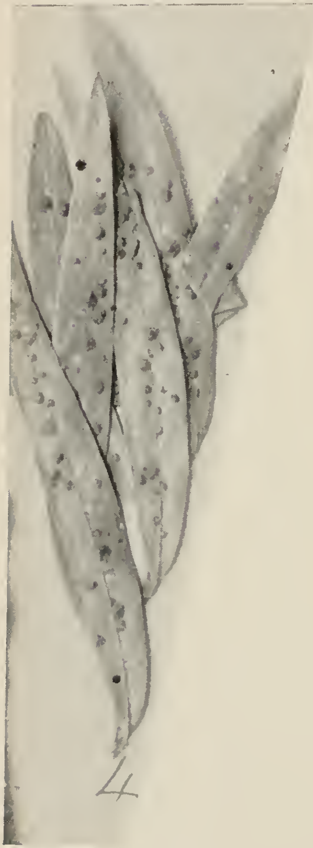

FIG. 119.—*Chrysomphalus rossi* (Mask.) on *Araucaria bidwillii.* (After Craw.)

Distribution.—Imported into California from Asia and Australia and now occurs in the central and southern parts of the State.

Food Plants.—Attacks *Araucaria bidwillii* in Los Angeles. Also works upon olives.

Natural Enemy.—The steel-blue lady-bird beetle, *Orcus chalybeus,* preys upon this scale.

THE PURPLE SCALE.

Lepidosaphes beckii (Newm.).

(Fig. 120.)

General Appearance.—The female scales are elongated, oyster-shaped, varying from one sixteenth to one eighth of an inch in length, and one third as wide. The male scales are much smaller than the females. The scale or covering varies from a reddish brown to a rich purple color, giving rise to the name.

Life History.—The pearly white eggs are laid in the large sac under the protecting scale. From these are hatched males and females, which mature in from four to six months. The fruit, limbs and foliage are attacked.

Distribution.—Throughout the coast citrus belt of Southern California. Also occurs in various places in the San Joaquin and Sacramento valleys.

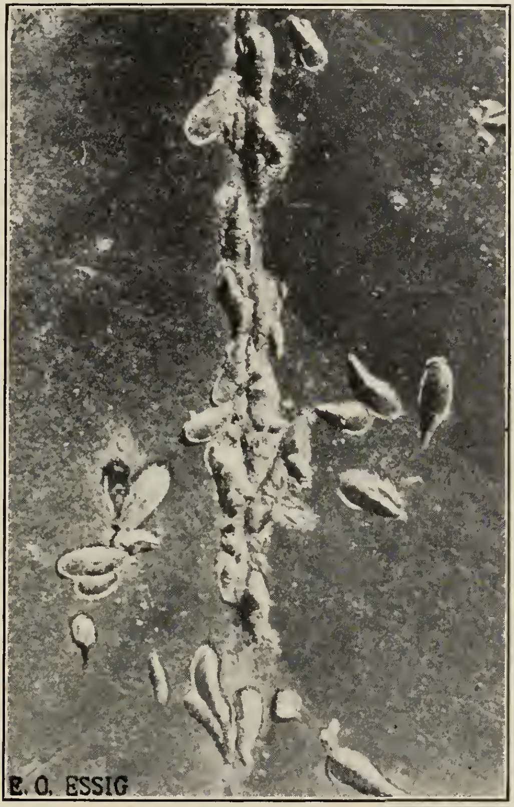

Fig. 120.—Purple scale, *Lepidosaphes beckii* (Newm.), on leaf. (Essig, Bull. 2, C. Pom. Cl.)

Food Plants.—All citrus species, fig, olive, croton, oak, *Elæagnus, Banksia integrifolia, Taxus cuspidata, Cercidiphyllum japonicum* and *Pomaderris apetala* are attacked.

Control.—Fumigate with full schedule No. 1. This is usually done when the black scale (*Saissetia oleæ*) is in good condition to kill.

Natural Enemies.—The ladybird beetles, *Orcus chalybeus, Scymnus marginicollis, Lindorus lopanthæ;* the larvæ of the green lacewing, *Chrysopa californica* Coq., and brown lacewing, *Sympherobius angustus* Bks., and the internal parasite, *Aspidiotiphagus citrinus* Craw., prey upon this pest.

GLOVER'S OR LONG SCALE.

Lepidosaphes gloverii (Pack.).

(Fig. 121.)

General Appearance.—Greatly resembles the purple scale, *Lepidosaphes beckii,* but is much straighter, longer and very narrow. The color is also somewhat lighter.

Life History.—Practically the same as the purple scale, but not so prolific or destructive.

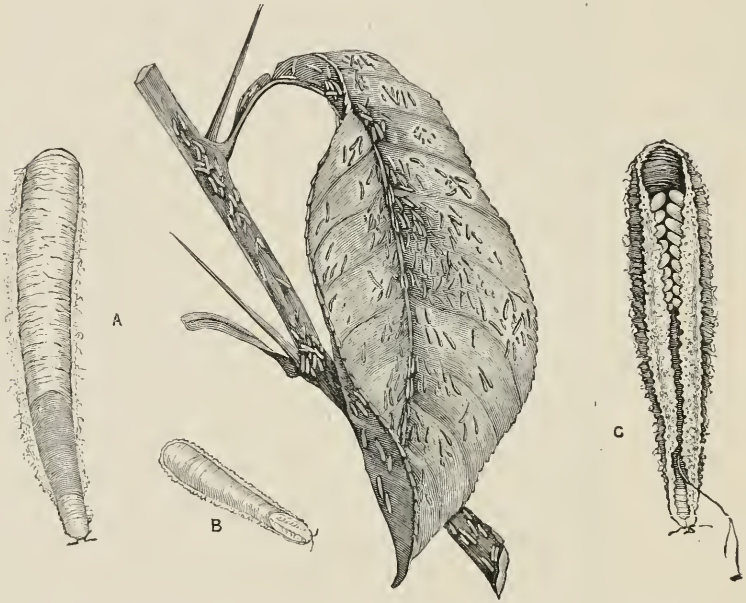

Fig. 121.—Glover's or long scale, *Lepidosaphes gloverii* (Pack.), on orange. A, scale of female; B, scale of male; C, ventral view of scale, showing eggs. (After Comstock.)

Distribution.—Occurs only in the most southern coast counties. The writer has received it from San Diego and Orange counties.

Food Plants.—Citrus trees, foliage and fruit; palms and *Magnolia fuscata* are attacked.

Control.—Same as for purple scale.

THE OYSTER SHELL SCALE.

Lepidosaphes ulmi (Linn.).

(Fig. 122.)

General Appearance.—The scales are like small miniature oyster shells, one eighth of an inch or less in length, and varying from light purple to almost black. The lighter body is situated at the small end. The male scales are very much smaller than the female.

Life History.—The females deposit their white pearly eggs, numbering from forty-five to a hundred, underneath the scale. The insect occurs in the colder climates and there are usually only two or three broods a year. The winter is spent in the egg state. This species works principally upon the bark, where it collects in great masses. Occasionally it attacks the fruits.

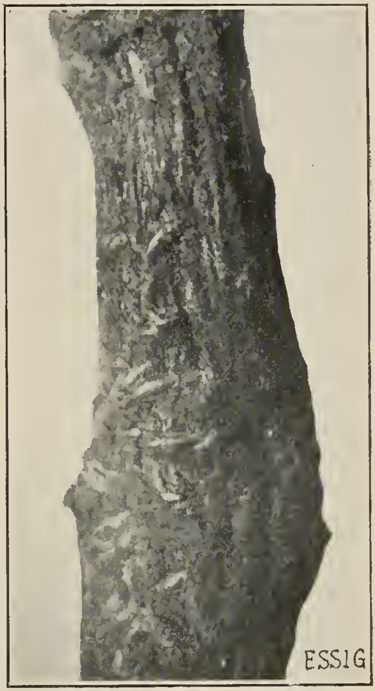

FIG. 122.—The oyster shell scale, *Lepidosaphes ulmi* (Linn.), on apple twig. (Original.)

Distribution. — Throughout the apple growing sections and more particularly in the northern part of the State.

Food Plants.—Apple, plum, pear, quince, maple, cherry, linden, willow, lilac, poplar, hawthorn, buckthorn, raspberry, rose, currant, hop-tree, horse-chestnut, blackberry, cottonwood, birch, butternut, dog wood, oak, *Ailanthus glandulosus*, *Ceanothus americanus*, *Sassafras officinale*, *Syringa persica*, *Cystisus*, tallow tree.

Control.—As this species usually occurs on deciduous fruit trees, spraying with lime-sulphur (1-9) during the winter is a very effective remedy.

THE DATE PALM SCALE.

Parlatoria blanchardii (Targ.).

(Fig. 123.)

General Appearance.—The female scales are very small, somewhat elongated in shape, and dark gray or almost black with white edges. The body beneath the scale is rose-colored. The male scales are white and considerably smaller than the females.

Life History.—Like other scales this species collects in great colonies, thus working much damage to the host plant. These colonies are most destructive during the summer months as the females are more or less dormant during the winter. Egg-laying begins early in the spring and continues through the early summer at least. Only a few eggs are laid by each female, but there are so many of these that the progeny is always tremendous. The eggs are protected under the posterior portion of the scale and as they hatch the young crawl forth to seek suitable feeding places. The males develop much quicker than do the females, and copulate immediately before dying. There are probably several uneven generations a year.

Distribution.—As this pest is confined to the date growing sections of the State, it is found only in the southern part and more particularly in Riverside and Imperial counties.

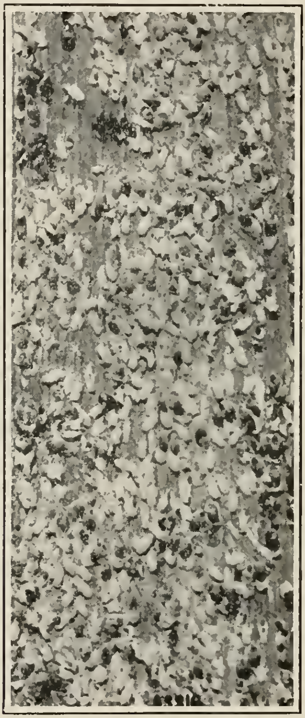

FIG. 123.—The date palm scale, *Parlatoria blanchardii* (Targ.), on leaf of date palm. (Original.)

Food Plants.—So far as known this scale feeds only upon the commercial varieties of date palms.

Control.—Burning over the trunks of the palm trees has proved an effective remedy for this scale.

Natural Enemies.—The principal enemies of this pest are the larvæ of the ashy gray ladybird beetle (*Olla abdominalis*), *Chilocorus cacti* and *Scymnus* sps. Internal parasites do very little to check it; in fact none of the natural enemies play an important part in its control.

THE CHAFF SCALE.

Parlatoria pergandii Comst.

(Fig. 124.)

General Appearance.—Small, circular, elongated, irregular scales with first exuviæ near the side. Male scales are decidedly longer than broad. The color is a light gray.

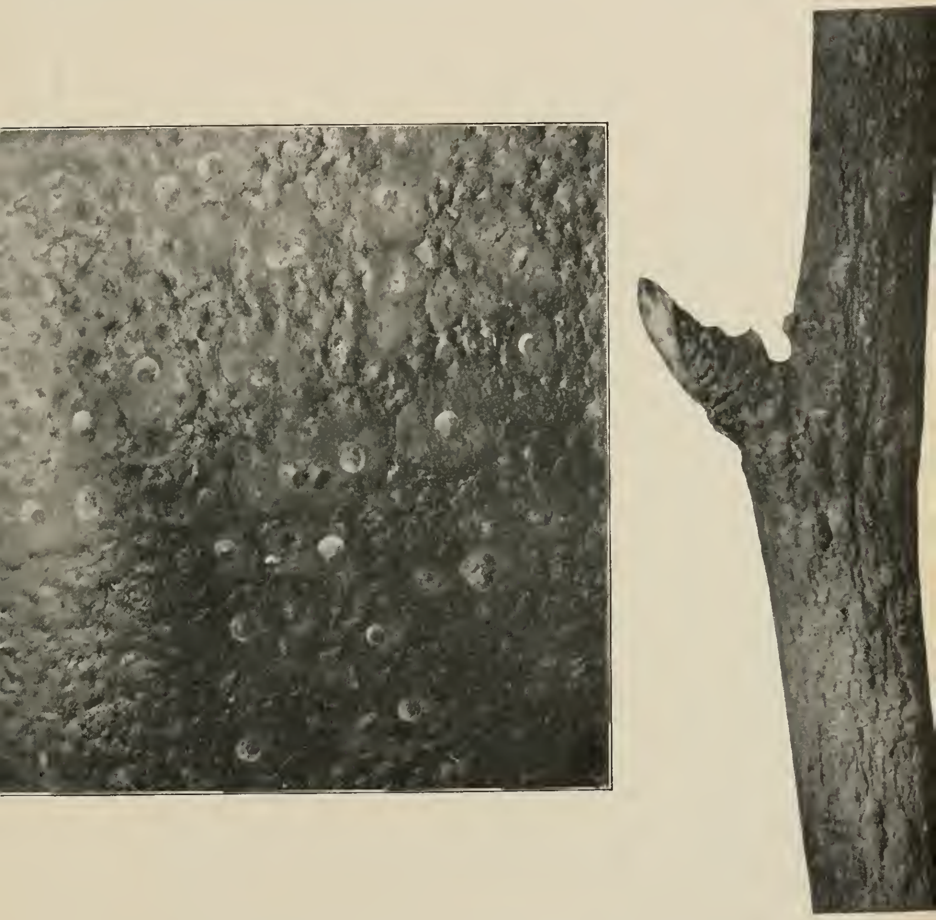

Fig. 124.—The chaff scale, *Parlatoria pergandii* Comst., on orange fruit at left and on orange twig at right. (Essig, P. C. Jr. Ent.)

Life History.—Quite a prolific species which does not spread very rapidly. The breeding continues through the summer and fall months and the broods overlap as in the other armored scales. The trunk, large and small limbs, foliage and fruits are attacked.

Distribution.—This species is limited to only a few localities in the State. It was first shown to the writer by C. H. Vary at Pomona, and was later found at Ventura. A. S. Hoyt reports it from Los Angeles.

It has also been found in a few other localities in the southern part of the State, having been imported from Florida.

Food Plants.—Orange, lemon, *Japonica* sp. All parts of the plants and the fruits are attacked.

Control.—Fumigation with full schedule No. 1. This is not a very difficult pest to combat.

ALEYRODIDÆ (Family).

MEALY WINGS OR WHITE FLIES.

This family is composed of very small insects closely allied to the coccids and plant lice. The beak seems to be inserted between the fore-legs; the feet are two-segmented; antennæ seven-articled in adults, prominent or wanting. There are four opaque, white wings which are present in males and females and are held flat over the body when at rest. The larvæ and pupæ are flat and greatly resemble scale insects.

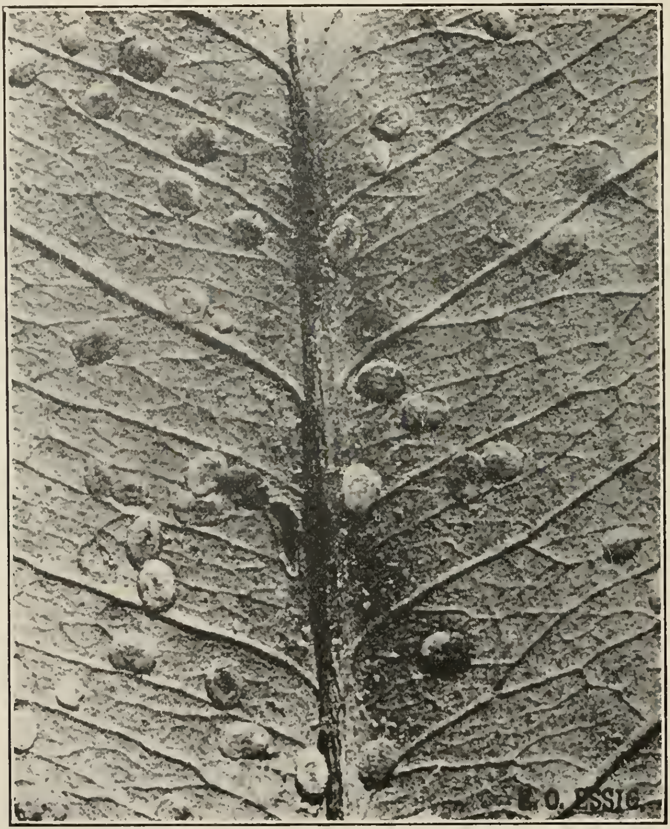

FIG. 125.—Larvæ and pupæ of the citrus white fly (*Aleyrodes citri* R. & H.) on the under side of an orange leaf. Enlarged three times. (Original.)

They are usually found only upon the foliage—the under sides of the leaves being favorite feeding places.

The distribution of the ordinary and indestructive members of this family is wide throughout the State, but the citrus infesting white fly is exceedingly limited and every possible means are being exercised by the State Commission of Horticulture to completely eradicate *Aleyrodes citri*, the only species now present.

The control of the white flies is the same as recommended for scale insects, and consists of spraying and fumigation.

Ladybird beetles and hymenopterous parasites prey upon these insects.

THE CITRUS WHITE FLY.

Aleyrodes citri Riley and Howard.

(Figs. 125, 126.)

General Appearance.—The adult white flies are about one tenth of an inch long; have yellow bodies and opaque wings covered with a fine white powder. The males have a characteristic tuft on the under side of the abdomen. The pale yellowish-green eggs are suspended on short stalks. The first hatched young have legs and antennæ like a small scale insect, but after moulting these disappear and the body becomes flat, greatly resembling a soft scale. The development of the insect takes place in the flattened shell which gradually becomes raised, showing segmentation and yellowish color. The adult emerges by breaking through the top of the skin.

Life History.—The winter is passed in the mature larval stage on the under sides of the leaves. Early in the spring the pupæ appear and in March and April the adults emerge. The eggs are deposited upon the foliage, the larvæ beginning to hatch in about three weeks. The first hatched have legs and appendages and greatly resemble a young scale. They soon settle to feed and after several months move no more until the adult stage is reached. There are several overlapping broods each year.

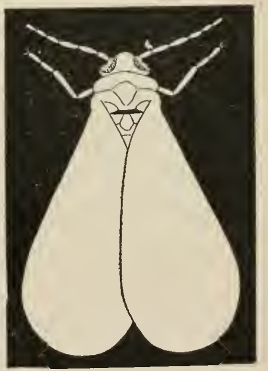

Fig. 126.—Adult citrus white fly (*Aleyrodes citri* R. & H.). Enlarged fifteen times. (After Quayle. Courtesy Cal. Exp. Sta.)

Distribution.—At the present time this pest is known to exist only in the city of Marysville where it infests yard trees. Continuous control measures have reduced it to almost a minimum. The white fly has been known to exist at Oroville and near Bakersfield, but in both places seems to have been exterminated. It has been found in a number of localities in the city of Sacramento, but all infested trees have been promptly destroyed.

Food Plants.—The principal food plants of economic importance are citrus trees, but the following are some of the other principal ones: Umbrella tree (*Melia azedarach*), Chinaberry (*Melia azedarach umbraculifera*), Cape jessamine, yellow jessamine, privets, Japan persimmon, lilac, coffee, English ivy, rubber tree, bay, tree of heaven, Cape myrtle and many minor ones.

Control.—By far the most effectual control measure is fumigation, as used for scale insects, two thirds of Schedule No. 1 being recommended. Emulsions and resin sprays are also effective remedies.

THE COMMON OR GREENHOUSE WHITE FLY.

Aleyrodes vaporariorum Westw.

(Fig. 127.)

General Appearance.—The adult white flies are about three fiftieths of an inch long, the males being slightly smaller than the females. The bodies are yellow and the wings pure white. The eggs are exceedingly small, oblong in shape, at first light green, growing black with age and attached by a short stipe. The larvæ are light in color, transforming to flat pupæ about three hundredths of an inch long; oblong-oval in shape; light green and supporting noticeable wax-like rods or spines, which makes this species readily distinguishable from all others.

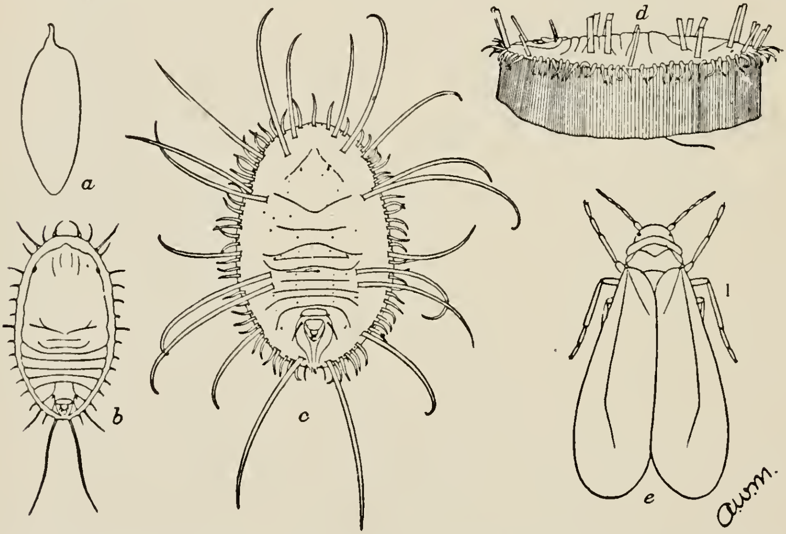

FIG. 127.—The common or greenhouse white fly (*Aleyrodes vaporariorum* Westw.). a, egg; b, young larva; c, pupa, top view; d, pupa, side view; e, adult. All greatly enlarged. (After Morrill.)

Life History.—The eggs are laid upon the leaves of the plants, each female depositing over one hundred. These hatch in about two weeks into larvæ which begin feeding very shortly and after three moults, covering nearly a week, they become pupæ, which after two more weeks are ready to emerge from the old pupal skins as adult insects. The adults feed constantly throughout their existence of some thirty days.

Distribution.—This species occurs in greenhouses in almost every part of the State. Due to the mild climate it also occurs in the open in nearly every section, especially in the central and southern parts.

Food Plants.—Tomatoes and cucumbers seem to suffer most from the attacks of this pest, though a large number of other plants are infested, including the bean, eggplant, melon, lettuce, grape leaves, aster, chrysanthemum, salvia, lantana, fuchsia, rose, coleus, geranium, primrose, ageratum, etc.

Control.—The same as for the citrus white fly (*Aleyrodes citri*).

HETEROPTERA (Suborder).

TRUE BUGS.

The members of this suborder comprise those commonly known as bugs. Most of them have wings which are thickened at the base and folded so as to make a distinct "X" upon the back. The young differ from the adults by lacking wings or by their small size.

Though most of them are destructive to vegetation, many are carnivorous and wage continual warfare upon injurious insects and animals.

In habits there is also a great variance, there being aquatic as well as land forms.

Many of them are known as "stink bugs," because of the peculiar and offensive odor which is secreted for protective purposes.

There are too many families comprising this suborder to admit of a description of each, so the families of the insects treated will be designated at the beginning of each description.

THE HARLEQUIN CABBAGE BUG.

Murgantia histrionica Hahn. (Family Pentatomidæ).

(Fig. 128.)

General Appearance.—The adult bugs are black with bright red markings, as shown in Fig. 128. They are one half inch long and two thirds as wide. The eggs are almost imitations of miniature white barrels with black hoops and black spots in the proper places for bungholes. They are arranged in clusters side by side. The young greatly resemble the adults, but lack wings and yellow predominates. This color gradually changes to orange and red as the nymphs reach maturity.

Life History.—The adults hibernate in various sheltered places over winter and appear with the first warm weather in the spring to feed. The first plants to furnish food are wild mustard, radish and other members of the cruciferous weeds. Upon these also the eggs are laid and the young soon appear in great numbers in time to migrate to the cabbage plants and work upon them throughout the summer. Successive broods may appear in the cabbage fields and the numbers so increase as to cause much damage. In the southern part of the State the adults continue active throughout the winter.

Distribution.—Throughout the entire State, but more often met with in the central and southern sections.

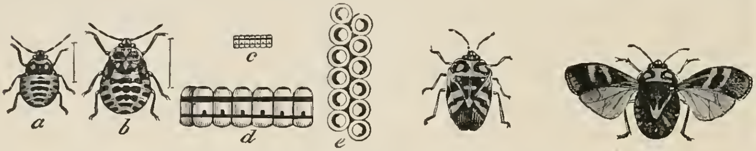

FIG. 128.—The cabbage bug, *Murgantia histrionica* (Hahn.). *a* and *b*, young; *c*, *d* and *e*, eggs; adults at right. (After Riley.)

Food Plants.—This bug is especially fond of all cruciferous plants, including mustard, radish, cabbage, cauliflower, turnips, rape, horseradish, etc. Other food plants are potatoes, eggplant, okra, beans, beets, roses, sunflowers, chrysanthemums, squash, ragweed, pigweed, wild lettuce, lambsquarters and most of the plants belonging to the caper family. Occasionally nursery trees, citrus, locust, cherry, and plum are injured, and the fruit of the grape and corn ears also suffer.

Control.—Methods recommended for the squash bug are also applicable to the control of the cabbage bug. Planting an early crop of cabbage, rape, mustard or radish is especially recommended. The eggs are laid in great numbers upon these plants and together with the adults may be destroyed. This practice greatly lessens subsequent attacks.

Natural Enemies.—Great numbers of the eggs are destroyed by two small internal parasites, *Trissolcus murgantiæ* Ashm. and *Oœncyrtus johnsoni* How. The wheel bug, *Arilus cristatus* Linn., feeds upon the young nymphs in the Eastern States.

THE COMMON SQUASH BUG.

Anasa tristis DeGeer. (Family Coreidæ).

(Fig. 129.)

General Appearance.—The small, somewhat three-sided eggs are dark metallic brown in color and laid in groups of from fifteen to forty. The freshly hatched bug is light green with pinkish appendages. As it ages the thorax becames black and the abdomen gray. The adults are dark grayish-brown above, mottled yellowish beneath, and about three fourths of an inch long. They secrete a very offensive liquid, the odor of which has led to their being called "stink bugs." They hibernate in winter in any dry protected place; under boards, rubbish, etc., or in barns or outhouses.

Life History.—The eggs are laid in the spring and early summer upon the under or upper surface of the leaves, or upon the stems of the vines. They hatch in about two weeks and the young bugs begin work upon the small plant, and continue throughout the larval and adult stages, often causing great damage. The period from egg to adult occupies from one to two months. The latter hibernate over the winter and are ready to begin egg-laying as soon as the vines are suitable. There is only one generation each year.

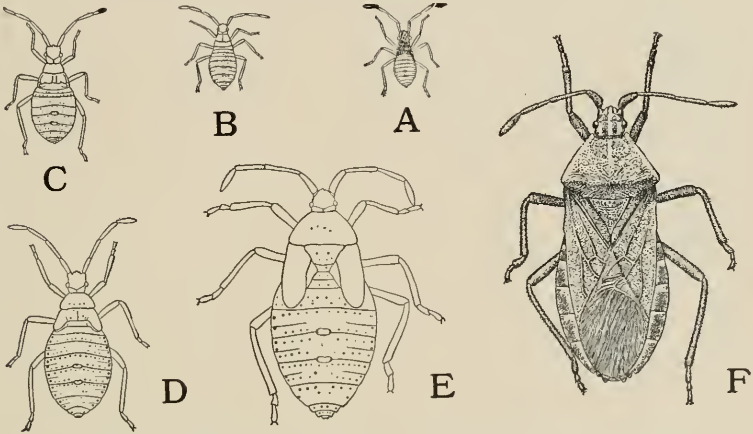

FIG. 129.—The common squash bug (*Anasa tristis* DeGeer). A-E, showing various stages in the development of the young; F, adult. (U. S. Dept. Agrcl.)

Distribution.—Throughout the State, but especially abundant in the central and southern parts.

Food Plants.—Most of the members of the squash family (*Cucurbitæ*), including the pumpkin, squash and gourd are attacked.

Control.—Hand picking is recommended early in the spring, as soon as the adults appear and begin egg-laying. The vines are so tender that spraying is impracticable. The bugs may be trapped by placing through the garden, boards, pieces of bark or similar material under which they may find shelter. They may then be collected in the early mornings and destroyed. Young plants may be covered to afford protection until they are able to resist the attacks. Repellants, such as gypsum saturated with kerosene or turpentine, scattered on the land help to drive them away. Clean culture is also an important aid—care being taken to burn all vines and rubbish in the fall. Thoroughly fertilizing the land may so stimulate plant growth as to make the attacks of the bug of little avail.

Natural Enemies.—In the eastern states the egg parasites, *Hadronotus anasæ* and *Oœncyrtus anasæ*, aid in controlling the pest. Parasites also work upon the growing and adult insects.

THE TARNISHED PLANT-BUG.

Lygus pratensis Linn. (Family Capsidæ).

(Fig. 130.)

General Appearance.—The mature bug varies from pale green to grayish brown, marked with yellow, black and red. The legs are pale brown or yellow with dark rings. The young bugs are lighter in color than the adults, without pronounced markings. All forms are exceedingly common and very active.

Life History.—Hibernation is usually passed in the adult stage, under any convenient shelter. In the early spring the females deposit their eggs directly upon the food plants. The young begin to feed as soon as hatched, and continue throughout their life history. This species is exceedingly prolific and its ability to travel rapidly and the large variety of food plants make it a constant menace.

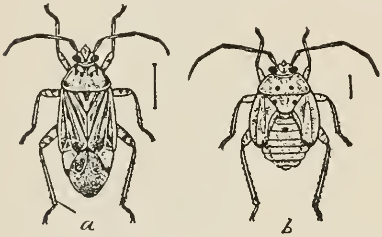

Fig. 130.—The tarnished plant-bug, *Lygus pratensis* Linn. *a*, adult, *b*, nymph. (After Chittenden.)

Food Plants.—This bug feeds on almost every kind of plant. It is especially abundant in grain or hay fields. All vegetable gardens afford a ready supply of food. It is often destructive to apple, pear and other fruit trees.

Control.—Because of its omnivorous habits and wide spread it seldom becomes a serious pest of any one crop. For the same reasons, control measures are most difficult. The presence of the insect need cause no alarm unless it is concentrating its attacks to a damaging degree upon cultivated crops. In such cases contact insecticides, such as emulsions, soap washes, tobacco sprays, resin washes, etc., may be used with deadly effect. These insecticides should be applied early in the morning and great care taken that they are not strong enough to injure the foliage of tender plants.

Clean culture serves to rid them from the fields before planting and to lessen the attacks the coming year.

THE CHINCH BUG.

Blissus leucopterus Say (Family Lygæidæ).

(Fig. 131.)

General Appearance.—The chinch bug is a very small black and white insect about 3 mm. long. The eggs are about one third as long as the adults, oval, and amber in color. The young vary from yellow and red to the color of the adults, depending upon the age.

Life History.—The winter is passed in hibernation by the adult insects. The eggs are laid into the grass sheaths or upon the stems above or below the ground in the early spring, several hundred being laid by each female. They hatch in a very short time and the young begin work immediately, collecting in dense colonies and doing great damage. They moult four times before full grown, there being two generations each year. The insects migrate very quickly when food becomes scarce in any locality.

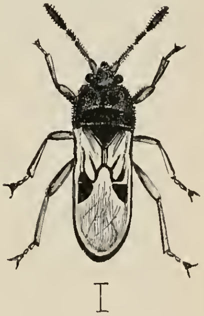

FIG. 131.—Adult female of the chinch bug, *Blissus leucopterus* Say. (After Riley.)

Distribution.—The writer has been informed by Mr. John Isaacs, former secretary of the State Commission of Horticulture, that the chinch bug has been present in the central part of the State for over twenty years, but during all that time it has not become a serious pest in a single locality.

Food Plants.—This insect feeds upon grains, grasses and corn. The destruction by it has been exceedingly great in the Middle States.

Natural Enemies.—A fungous disease works upon the chinch bug during wet weather and while it does great execution, it is not an important controlling factor.

THE FALSE CHINCH BUG.

Nysius angustatus Uhl. (Family Lygæidæ).

(Fig. 132.)

General Appearance.—The adults are very small grayish-brown bugs, about one eighth of an inch long. The young are somewhat lighter in color, having reddish-brown abdomens and lacking wings. The legs and antennæ appear very long and are dark.

Life History.—The eggs are deposited in the spring and early summer by the adults which have hibernated during the winter. The young are dull gray or brownish-red, and collect in great numbers upon the host plants. The life cycle is short, there being many successive broods each year.

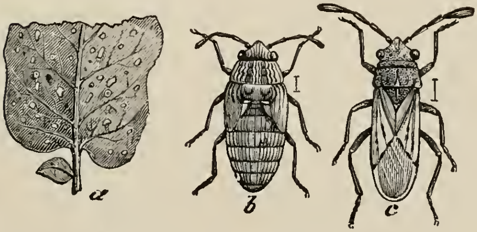

FIG. 132.—The false chinch bug (*Nysius angustatus*). a, potato leaf showing work; b, nymph; c, adult. (After Riley.)

Distribution.—Throughout the entire State. One of the commonest destructive insects.

Food Plants.—Many plants are seriously attacked, particular damage being done to grapevines, lettuce, potatoes, strawberries, grasses, purslane and foliage of apple trees. Cruciferous plants, including cabbage, turnips, mustard and radishes are favorite foods.

Control.—As this bug breeds largely upon wild plants, such as mustard, radish, purslane, etc., clean culture should be practiced to eliminate these food plants. Severe attacks to grapevines and young trees have resulted from allowing such weeds to grow in the orchards.

Soap emulsions and tobacco sprays are excellent remedies. Pyrethrum is also recommended, but is too expensive for large plantings.

THE MINUTE FALSE CHINCH BUG.

Nysius angustatus minutus Uhl. (Family Lygæidæ).

General Appearance.—The appearance of this insect is so much like the false chinch bug that it is commonly believed to be the same species. In fact it is the size that is the main difference, the minute variety being only about half as large (one sixteenth of an inch long).

Life History.—Practically the same as for the larger form.

Distribution.—Especially abundant in the southern part of the State, though the species occurs in all parts.

Food Plants.—The insect is especially destructive to sugar beets grown for seed. In the southern part of the State it works upon many wild plants and occasionally attacks citrus trees after the cover crop has been plowed under. Such attacks are forced, due to the destruction of the native food plants. It has been collected in large numbers on cultivated flowers.

Control.—Same as for the false chinch bug.

PARASITA OR ANOPLURA (Suborder).

TRUE LICE.

To this family belong the true lice, which are parasitic upon warm-blooded animals, including human beings. A discussion of the various members is of no value to a work of this sort.

NEUROPTERA (Order).

LACE OR NERVE-WINGED INSECTS.

BROWN LACEWING, GREEN LACEWING, ANT-LIONS, CADDIS FLIES, ETC.

The members of this family have quite large membranous wings with lace-like veins. They have complete metamorphosis—the larvæ being entirely different from the pupæ and adults. The mouth-parts are for biting. Practically all the insects of this order are beneficial, being predaceous upon other insects.

The larvæ of many of the families are aquatic in habits but the adults of all species live in the air and upon the land.

The most important and beneficial family is the *Chrysopidæ,* but the *Hemerobiidæ*, *Raphidiidæ* and *Myrmeleonidæ* are efficient destroyers of many injurious insects.

THE BROWN LACEWING.

Sympherobius angustus Banks (Family Hemerobiidæ).

(Figs. 133, 134.)

General Appearance.—The general appearance and shape are considerably like the well-known green lacewing, but the wings are not so slender. The ground color is brown with many darker blotches on the wings.

Life History.—The eggs are deposited among or near suitable prey and hatch into slate-gray and tan-colored larvæ, which are very active. One very noticeable characteristic is the constant movements of the head when searching for food. When full grown they are nearly one half an inch long. The larvæ spin thick white cocoons, in which to pupate. This requires but a few days or weeks when the adults emerge.

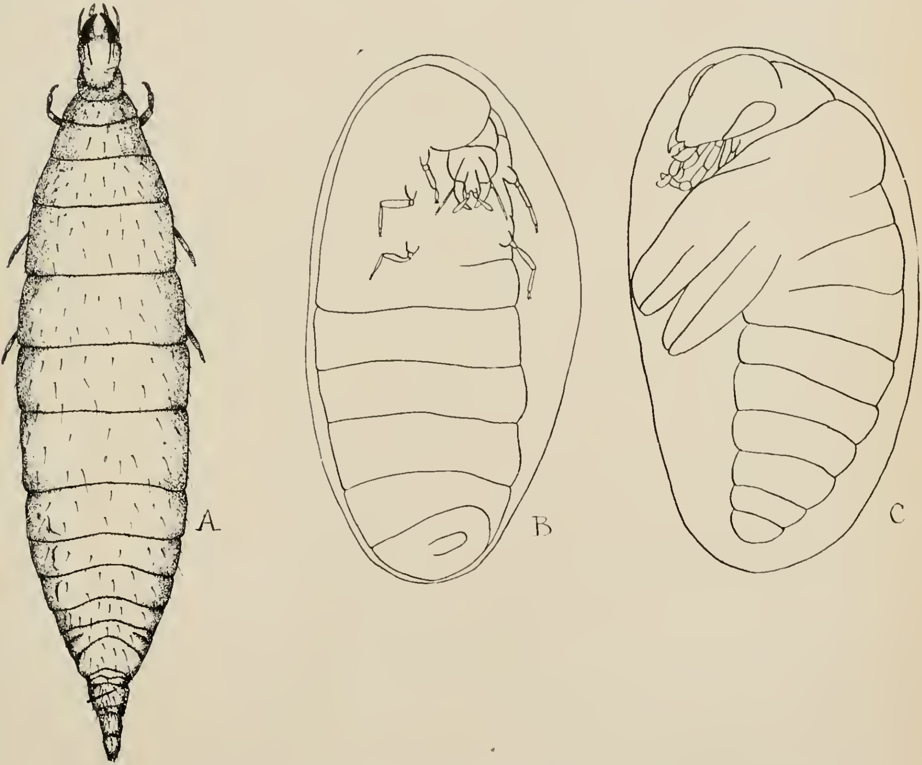

FIG. 133.—The brown lacewing. A, larva; B and C, pupæ in the cocoons. Much enlarged. (Essig, P. C. Jr. Ent.)

Distribution.—Throughout the central and southern parts of the State.

Hosts.—Many soft-bodied insects including plant lice and scales. It is a very efficient predator on the young of the citrus mealy bug (*Pseudococcus citri*).

Natural Enemies.—This insect would be far more useful if it were not in turn preyed upon by a hymenopterous parasite (*Isodromus*

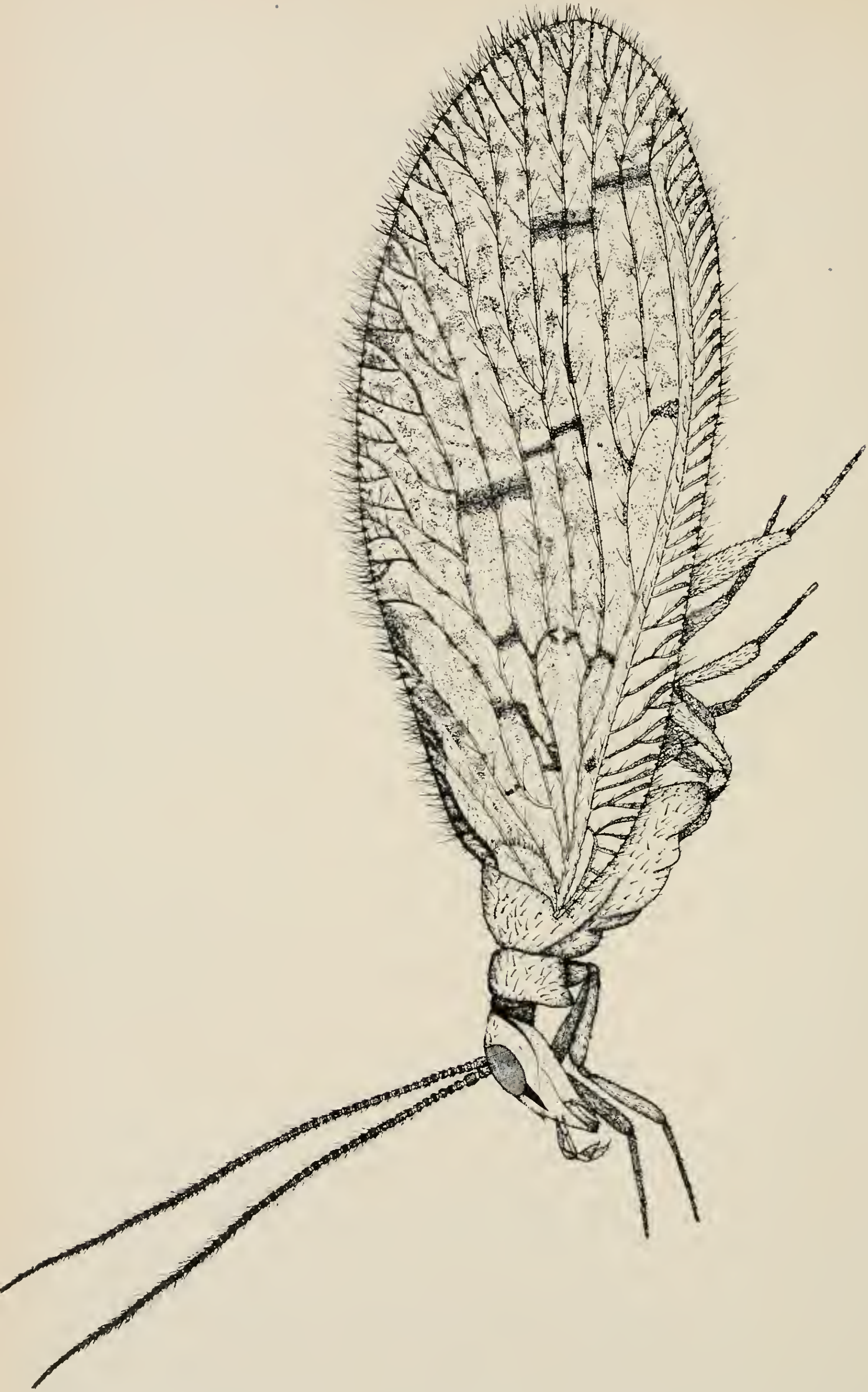

FIG. 134.—Adult female of the brown lacewing (*Sympherobius angustus* Banks). Very much enlarged. (Essig, P. C. Jr. Ent.)

iceryæ How.), which works on the pupæ in the cocoons. In not a few instances fifty to seventy-five per cent are parasitized.

THE GREEN LACEWING.

Chrysopa californica Coq. (Family Chrysopidæ).

(Fig. 135.)

General Appearance.—The adult form is well known to all by its delicate green lace wings and long hair-like antennæ. The body is also green with a longitudinal yellow stripe extending the full length on the dorsum, which distinguishes this species from all other forms.

Life History.—The eggs are oblong, pearly-white and attached to a fine stalk, which suspends them nearly one half inch in the air. The young vary from one eighth to nearly an inch in length; are yellow with reddish markings and characterized by their long sickle-like jaws. The larvæ are great feeders upon all small soft-bodied insects and are efficient aphid destroyers. The cocoons are globular and white, being fastened by supporting threads. All forms are abundant in summer and may be found throughout the entire year in the southern part of the State.

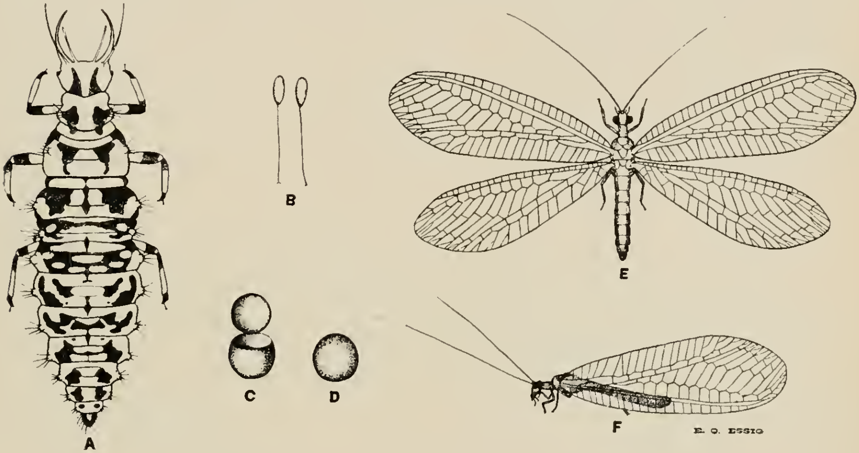

FIG. 135.—The green lacewing (*Chrysopa californica* Coq.). A, larva; B, eggs on the slender stalks; C, cocoon opened; D, cocoon closed; E and F, adult females. (Essig, P. C. Jr. Ent.)

Distribution.—Throughout the entire State.

Hosts.—Preys upon all soft-bodied insects, including plant lice, mealy bugs, young scales, larvæ of many coccinellids and upon all of our common mites. They are also cannibalistic. Their work is usually the destruction of insect pests, but they often do great damage in destroying the larvæ of introduced ladybird beetles. The pupal forms are preyed upon by internal parasites, which keep down their numbers to a considerable degree.

LEPIDOPTERA (Order).

SCALE-WINGED INSECTS.

MOTHS AND BUTTERFLIES.

The members of this order are among the most familiar of all insects. Most of the adults have four well developed wings which are characterized by being covered with scales or modified hairs, the arrangement of which is responsible for the varied and beautiful color pattern in so many species. The bodies are covered with fine soft hair. All have complete metamorphosis—the larvæ being known as cut worms, army worms or caterpillars, and the pupæ as chrysalids. The mouthparts of the larvæ are for biting and chewing while those of the adults are abortive or for sucking.

The larvæ of all species are very destructive to plant life and all may be considered injurious with the exception of the silkworm moth, which is of great commercial importance in other countries.

SPHINGIDÆ (Family).

SPHINX OR HAWK MOTHS.

The adult moths of this family are primarily night-flyers, though occasionally one may be seen on dark days. Just before nightfall numbers may also be observed as they begin their night's work. They are among the largest moths, some individuals having a wing expanse of from four to six inches, though the ones discussed here are medium sized.

The caterpillars are very large and robust, being beautifully marked with bright colors, especially with characteristic colored spots around the breathing spiracles, along the sides of the bodies.

The chrysalids or pupæ are easily distinguished from all other species by the proboscis which is curved from the head to the body like a pitcher handle.

The caterpillars of all these moths are very harmful. Their great size and ravenous appetites enable them to devour great quantities of vegetation.

General Life History.—The winter is passed in the chrysalis stage of the second brood. The adults emerge early in the spring and soon begin egg-laying, the eggs being usually deposited directly upon the leaves, singly or in small groups. These hatch in about a week—the young caterpillars beginning to feed upon the tender foliage first. When full-grown they descend from the plants and either pupate in the earth or among leaves or refuse. There are usually two broods a year—the moths of the first brood emerging about the middle of the summer, while those of the second brood do not emerge until the following spring.

Control.—Though the various members of this family are very common, it seldom happens that the young are seen in any great numbers, but individuals are often met with. The work is usually evident long before the worms are detected. Because of their large size and characteristic work they are comparatively easy to locate and upon these facts are based the method of hand picking as a control measure. The worms are either gathered and destroyed or simply cut in two with a pair of scissors.

Poison sprays will also serve to hold them in check, but such a method is not practical in dealing with pests of fast growing plants like tomatoes, tobacco, grapevines, etc., because of the great number of applications necessary to keep all the foliage properly poisoned.

THE WHITE-LINED SPHINX.

Celerio lineata (Fab.) (Family Sphingidæ).

(*Deilephila lineata* Fab.)

(Fig. 136.)

General Appearance.—This is a very common insect. The adult moths are quite large, having a wing expanse of nearly three and one half inches. The fore-wings are green with broad brown bands on the front and apical margins and in the middle of each. The veins are white. The hind wings are very small, dark brown with a wide lighter band across the middle of each. The thorax is grayish with distinct white lines, while the abdomen is dark green marked with black and white spots. The larvæ are quite large, often more than three inches long. The color varies considerably, but is usually light

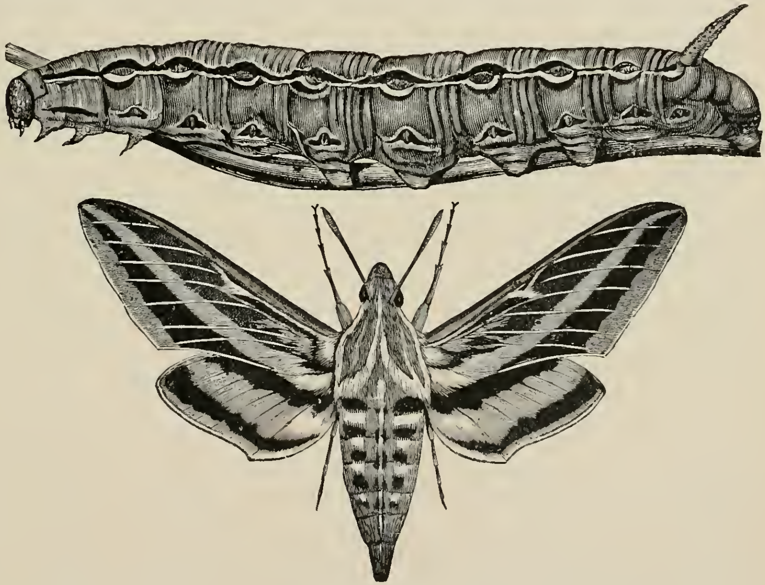

Fig. 136.—The striped morning or white-lined sphinx, *Celerio lineata* (Fab.). Larva and adult. (After Riley.)

green with a row of spots along each side of the back. The spiracles, just above the feet, are margined with black and yellow. A pale yellow line extends down the middle of the back. The chrysalis is dark brown.

Distribution.—Common throughout the entire State.

Food Plants.—The larvæ of this species are so common as to be often mistaken for other members of the family. They are usually found feeding upon the foliage of the apple, grape, pear, melon and tomato vines.

THE TOMATO SPHINX.

Phlegethontius sexta Johan. (Family Sphingidæ.)

(*Protoparce sexta* Johan.)

(*Protoparce carolina* Linn.)

(Fig. 137.)

General Appearance.—The larvæ of this moth are exceedingly large, often attaining a length of nearly four inches. They are green in color with showy oblique, white stripes, and highly colored spiracles along the side. They always have the characteristic curved spine on the last segment, which is red in this species. The crysalis is rich brown and nearly two inches long. The adults are two inches long, having a wing expanse of from four to five inches. The general color is gray with orange or yellow spots on each side of the abdomen. Figure 138 shows the color patterns very well.

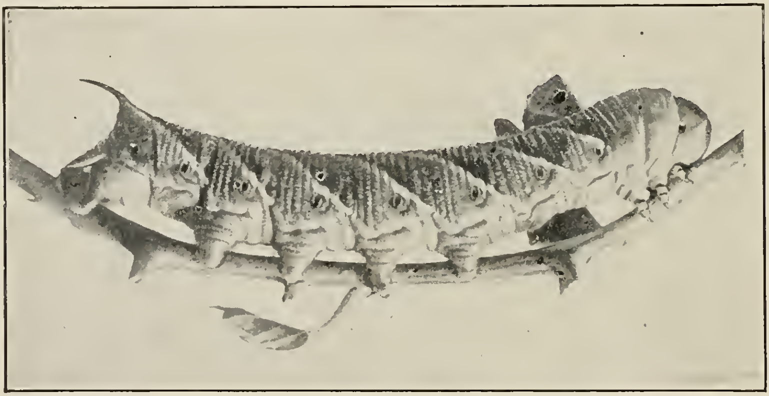

FIG. 137.—Larva of the tomato sphinx (*Phlegethontius sexta* Johan.). Natural size. (After Folsom.)

Distribution.—Exceedingly common throughout the entire State.

Food Plants.—The larvæ work largely upon tomato plants, often defoliating large areas. They also attack potato, tobacco and various *Solanaceæ*.

Natural Enemies.—Internal parasites perform an important part in the control of this pest and are responsible for the comparatively small amount of damage done.

THE TOBACCO SPHINX.

Phlegethontius quinquemaculata Haw. (Family Sphingidæ.)

(*Protoparce quinquemaculata* Haw.)
(*Protoparce celeus* Hübn.)

(Fig. 138.)

General Appearance.—All forms of this species greatly resemble those of the tomato worm in size and general appearance. The lateral oblique, white stripes of the larvæ do not extend as far up the back in the tobacco worm as in the tomato worm. There are also longitudinal white stripes below the spiracles, forming "V's" with the oblique stripes. The horn at the tip of the body is black. The chrysalis has a much longer tongue case in this species than has that of the tomato worm. The adults are about the same size, this species being duller and with less distinct white markings. The abdomen is more pointed; the spots are lighter orange in color and two less in number than in the tomato spinx.

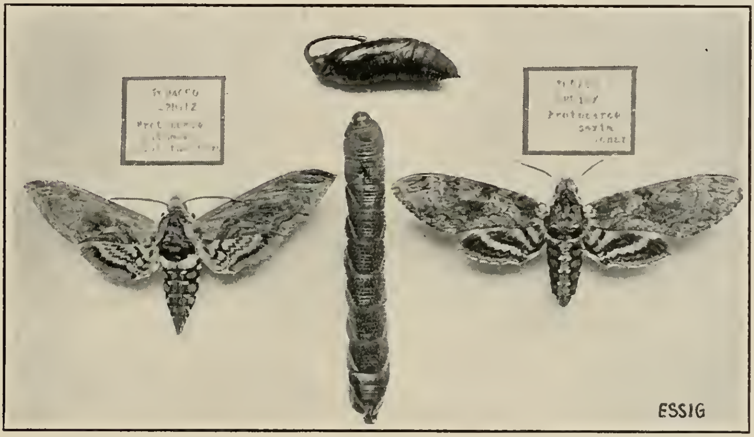

Fig. 138.—The tobacco sphinx (*Phlegethontius quinquemaculata* Haw.) at left and the tomato sphinx (*Phlegethontius sexta* Johan.) at right. The chrysalis and larva are of the tobacco sphinx. (Original.)

Distribution.—Throughout the entire State. One of the common insects.

Food Plants.—The principal food plants of this insect are tobacco and tomato, though they feed upon various varieties of the *Solanaceæ*.

Natural Enemies.—Internal parasites prey upon the larvæ and greatly aid in keeping down the numbers.

THE ACHEMON SPHINX MOTH.

(*Pholus achemon* (Drury) (Family Sphingidæ).

(*Philampelus achemon* Drury.)

(Fig. 139.)

General Appearance.—The adult moth is of a brownish-gray color with light and dark variegations and well defined dark brown spots. The hind wings are rich pink with brown border and dark spots. The body is reddish gray with two deep brown triangular spots on the thorax. The expanded wings measure easily four inches across. The larva or caterpillar is first green, changing to reddish-brown as it grows older. The dorsum is brown with from six to eight whitish, oblique bars along the sides. The pupæ are rich brown.

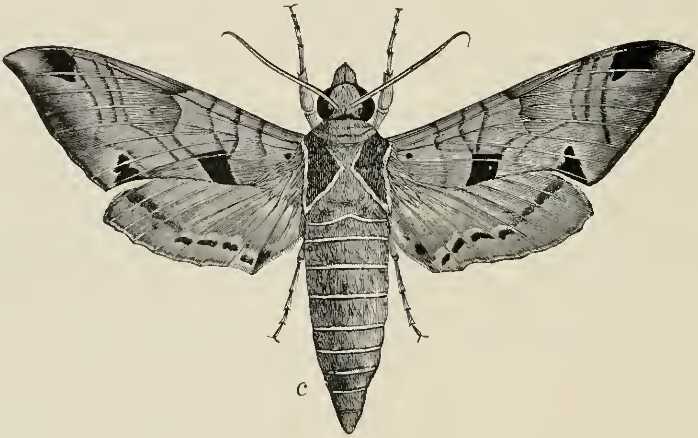

FIG. 139.—The Achemon sphinx, *Pholus achemon* (Drury). (After Riley.)

Life History.—The eggs are green and round. The winters are passed in the chrysalis stage, the adults emerging about the time the foliage appears upon the grapevines. The eggs are glued to the leaves and hatch in a comparatively short time into small green caterpillars. These are ravenous feeders, grow very rapidly and do much damage to the foliage of the vines. In about one month they are full grown and go into the ground to pass the winter in the pupal stage.

Distribution.—Common throughout the entire State, but most troublesome in the central part.

Food Plants.—The caterpillars feed upon wild and cultivated grapevines and the Virginia creeper.

NOCTUIDÆ (Family).

ARMY AND CUT WORMS.

The adult members of this family are practically all night-flyers. The young caterpillars of many are known as cut and army worms and are among the most destructive insect pests, due to their great numbers which often advance from field to field like an army devastating as they go. Like the grasshoppers they attack practically all kinds of plants, including field and truck crops, vineyards and orchards, as well as flowers and weeds.

The eggs are laid in the spring by the adults and the larvæ become exceedingly numerous in early summer, when most of the damage is done. The pupal stage is passed underground; the light or dark-brown, naked chrysalids being housed in small earthern cells. There are several broods a year. The winter is usually spent in the pupal stage, but some adults also hibernate.

Control.—The control of these insects has afforded difficult problems for years, and even to-day the methods worked out do not always afford the necessary relief.

Clean culture during the fall of the year and thorough plowing of infested fields to break up the hibernating pupæ cases often greatly reduce the next year's broods. This is especially important in pea fields.

When the worms begin to march, trenches should be plowed across and ahead of their paths with a perpendicular wall in front of the advance. The worms not being able to cross will gather in great masses in these trenches and can be easily killed with crude oil or by crushing with a narrow disk or roller. Arsenical sprays applied as soon as the worms begin to appear will also materially aid in protecting crops like potatoes, tomatoes, young trees, vines, etc., but are seldom practical for forage crops.

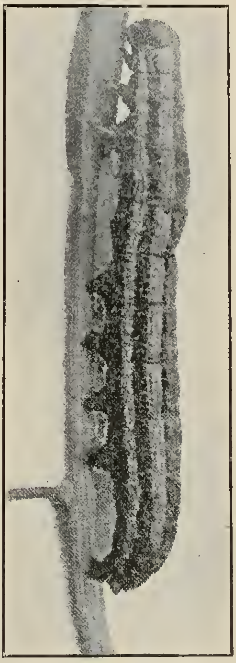

FIG. 140.—A climbing cutworm, fully matured. (U. S. Dept. Agrcl.)

Poisoned bait, composed of a pound of paris green to forty or fifty pounds of bran and sweetened either with cheap sugar or molasses with sufficient water added to make a stiff mash, placed in the infested areas, will kill countless numbers of the worms.

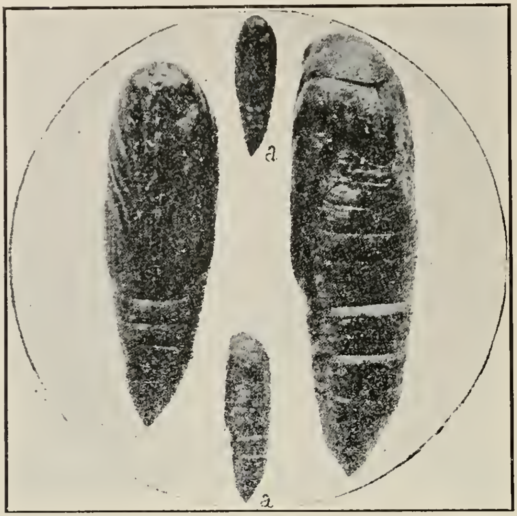

FIG. 141.—Pupæ into which the army worms transform after they have burrowed into the ground. The adult moths come from these chrysalids; a, natural size. (U. S. Dept. Agrcl.)

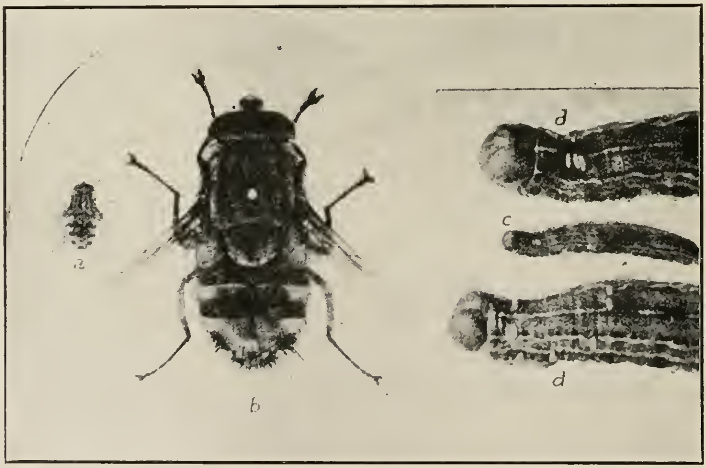

FIG. 142.—The red-tailed Tachina fly (*Winthemia 4-pustulata* Fab.) which is an effective parasite of cutworms and army worms; a, fly natural size; b, fly much enlarged; c, army worm upon which the fly has laid eggs, natural size; d, parasitized army worms, enlarged. (U. S. Dept. Agrcl.)

Natural Enemies.—By far the most important factors in the control of army and cut worms are natural enemies. The parasitic tachinid flies kill countless numbers of the worms. Hymenopterous parasites of the family *Ichneumonidæ* also prey upon the young. The predaceous ground beetles of the family *Carabidæ* devour the worms and destroy great numbers. That these worms are not injurious every year is due wholly to the work of these natural enemies.

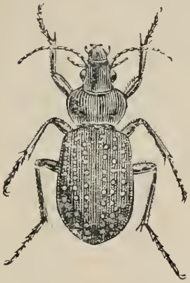

FIG. 143.—A carabid beetle (*Calosoma calidum* Fab.) which preys upon army and cut worms in the Middle and Eastern States. This beetle does not occur in California, but there are many carabids here looking like this except that they are wholly black. (After Lugger.)

THE ALFALFA LOOPER.

Autographa gamma californica Speyer (Family Noctuidæ).

(Fig. 144.)

General Appearance.—The adult moths have a wing expanse of about one and one fourth inches with the body a little over one half an inch long. The fore wings are light bluish-gray with rose or rust-colored and light markings, a very distinctive feature of which is one shaped like the Greek letter gamma near the middle. The hind wings and body are dull gray. The eggs are hemispherical and pale yellow.

The young caterpillars are light green while the fully developed forms are dark olive-green; head light green; three dark longitudinal lines on the body; a dark spot back of the eye. There are three pairs of well-developed front legs, two pairs of abdominal legs just back of the middle, and one pair at the extreme posterior end. When full grown the larvæ attain a length of about one inch. The cocoon is loosely spun of white silk; the chrysalis being brownish black in color, or paler.

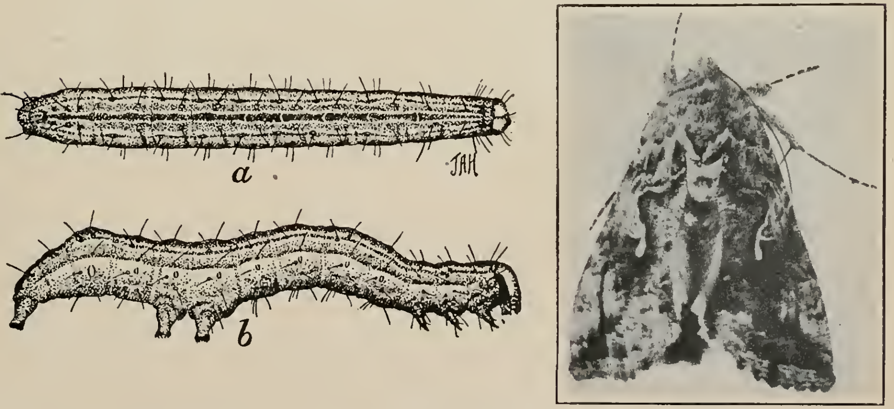

FIG. 144.—The alfalfa looper (*Autographa gamma californica* Speyer). a and b, dorsal and lateral views of the larvæ; adult moth at the right. All enlarged. (After Hyslop.)

Life History.—According to J. A. Hyslop, of the United States Department of Agriculture, this insect passes the winter in the pupal and adult stages, the moths appearing early in the spring and are especially active, laying eggs in May and June in the alfalfa fields. The young larvæ or loopers are plentiful in June, feeding upon the leaves of the plants. In about two weeks they are full-grown and spin a loose white cocoon among the leaves, in which to pupate. After twelve days the adult moths emerge. The entire life cycle requires about a month. There are two generations a year—the second broods coming on in July.

Distribution.—Throughout the central and southern parts of the State, having been collected in Placer, Alameda, Kern, Fresno and Los Angeles counties. It is probably quite widely distributed in other sections.

Food Plants.—The larvæ are very destructive to alfalfa, working upon the leaves and blossoms. They also feed upon clover, garden peas, cabbage, barley, elder, dock and wild malva.

Natural Enemies.—As very well shown by Mr. Hyslop, this insect is so held in check by natural enemies that artificial remedies are yet unnecessary. Internal hymenopterous parasites and tachinid flies are responsible for the good work. In the State of Washington five of the former and two of the latter have been recorded.

THE BEET ARMY WORM.

Laphygma exigua Hübn. (Family Noctuidæ.)

(*Caradrina exigua* Hübn.)

(Fig. 145.)

General Appearance.—The adult moth is mottled gray with distinct light markings on the fore wings. It is about one inch in length, with a wing expanse of one and one half inches. The larvæ are slender, dark green in color and distinctly striped.

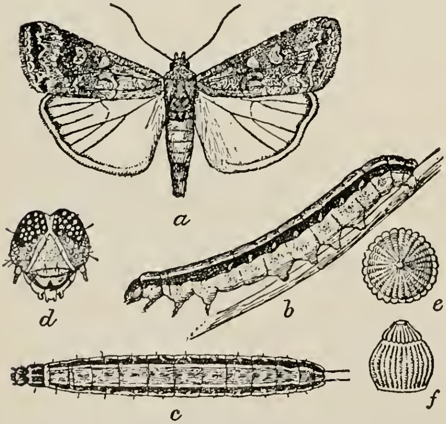

FIG. 145.—The beet army worm, *Laphygma exigua* Hübn. a, adult moth; b, larva, lateral view; c, larva, dorsal view; d, head of larva; e, dorsal view of egg; f, side view of egg. Enlarged. (After Chittenden.)

Life History.—The adult moths appear during the months of April and June and deposit eggs, the caterpillars hatching out in May and the last of June and becoming most abundant in August. There are probably three generations a year—the first and last doing the least amount of damage.

Distribution. — Generally distributed throughout the State, but more abundant in the middle and southern parts.

Food Plants.—The favorite food of the caterpillars is the sugar beet and it bids fair to become quite a serious pest to that crop. Table beets, corn, potatoes, peas, onions, sunflower, lambsquarters, pigweed, saltbush and the leaves of the apple, mallow, wild tobacco, plantain and wild grasses are also attacked.

THE WESTERN ARMY WORM.

Chorizagrotis agrestis Grote (Family Noctuidæ).

(Fig. 146.)

General Appearance.—The adult moth is about one inch long and dark brown with gray markings. The caterpillars or army worms attain a length of two inches and vary from pale green to dark brown.

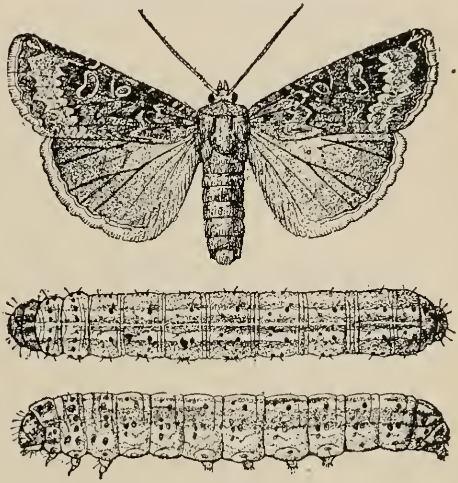

Fig. 146.—The western army worm, *Chorizagrotis agrestis* Grote, showing adult moth and larvæ. Enlarged. (After Chittenden.)

Life History.—The general life history is practically the same as that of the variegated cutworm (*Peridroma margaritosa* var. *saucia* Hübn.).

Distribution. — Occurs in all parts of the State.

Food Plants.—This is a rather serious vegetable pest, attacking beets, cabbage, horse-radish, radish, mustard, turnip, peas, tomatoes, potatoes, onions, celery, rhubarb, corn, grasses, clover, alfalfa and forest and fruit trees.

THE COMMON CUT WORM.

Euxoa atomaris (Smith) (Family Noctuidæ).

(*Agrotis atomaris* Smith.)

(Fig. 147.)

General Appearance.—The caterpillars are light gray in color, smooth, and, when full-grown, measure about one and one half inches in length. The adult moth is about one inch long with a wing expanse of two inches. The color of the fore wings is almost uniform gray with paler markings, while the hind wings are much lighter.

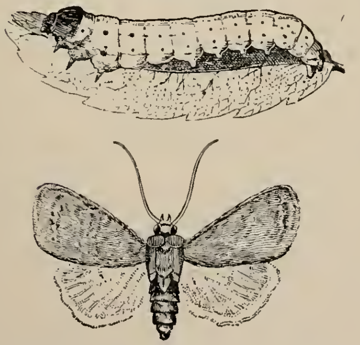

Fig. 147.—Larva and adult of the common cutworm, *Euxoa atomaris* (Smith) (Cal. Hort. Com.).

Life History.—The eggs are laid early in April by moths shortly emerged from the over-wintering cocoons. The young caterpillars burrow into the loose soil during the day and feed at night. When full-grown they go into the soil, transform into dark brown chrysalids and thus pass the winter in small cells, the moths hatching out the following spring.

Distribution.—Especially abundant in the San Joaquin Valley, though the species is widely scattered throughout the State.

Food Plants.—Particularly injurious to grapevines and prune trees though the larvæ feed upon a great many other plants.

THE TOMATO, CORN EAR-WORM OR COTTON BOLL-WORM.

Heliothis obsoleta Fab. (Family Noctuidæ).

(*Heliothis armiger* Hübn.)

(Fig. 148.)

General Appearance.—The adult moths are day as well as night flyers and are exceedingly common. They are nearly one inch long and grayish or brownish in color, with or without markings upon the fore wings. The eggs are dirty yellowish-white in color. The larvæ are nearly two inches long when full-grown and vary from yellowish to brownish in color with longitudinal gray and white stripes and with eight dark spots or tubercles on each segment. The pupæ are rich brown.

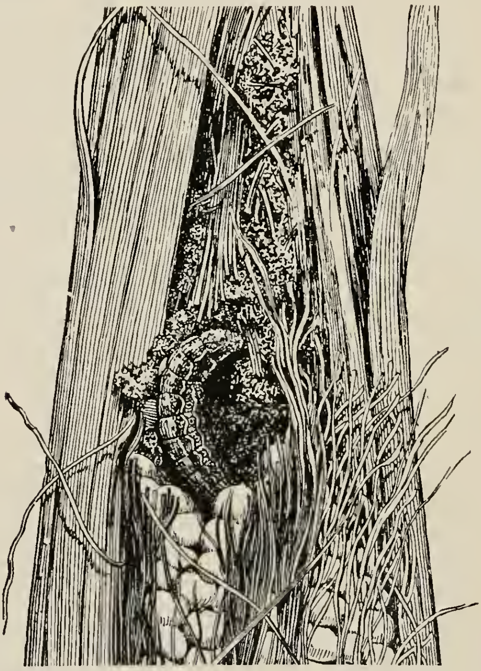

FIG. 148.—The corn ear-worm. *Heliothis obsoleta* Fab. (U. S. Dept. Agrcl.).

Distribution.—Exceedingly common in all parts of the State.

Food Plants.—This species is perhaps most commonly known in

California as the corn ear-worm from its attacks upon the ears of sweet corn. The larvæ enter near the silk end and destroy either the tip or the whole ear. The damage done is often enormous. The fruit of the tomato is also attacked, the worm eating large holes into the bottoms or sides and thus causing decay. In the Southern States this species works upon the cotton bolls and is there known as the cotton boll-worm.

Control.—The control of this pest is somewhat more complicated than in the case of the ordinary cutworms, due to the fact that the young worms work in the ear of the corn, in the tomato or cotton boll and are thoroughly protected from external remedies. The use of early-ripening varieties as well as a trap crop is highly recommended. Spraying the young ears, tomatoes, or bolls with poisoned sprays gives relief if the work is done thoroughly and often, but it must be begun before the worms are inside.

Natural Enemies.—Natural enemies do little effective work in controlling this pest. The tachina fly (*Frontina armigera* Coq.) preys upon it in California.

THE VARIEGATED CUTWORM.

Peridroma margaritosa var. *saucia* Hübn. (Family Noctuidæ).
(Fig. 149.)

General Appearance.—The adult moths, or millers, are grayish brown with light markings, measuring about one inch in length. The cutworms are rather dull brown, mottled with gray or dark above with a row of from four to six yellow spots on the middle of the back. They are about one and three fourths inches long when fully developed.

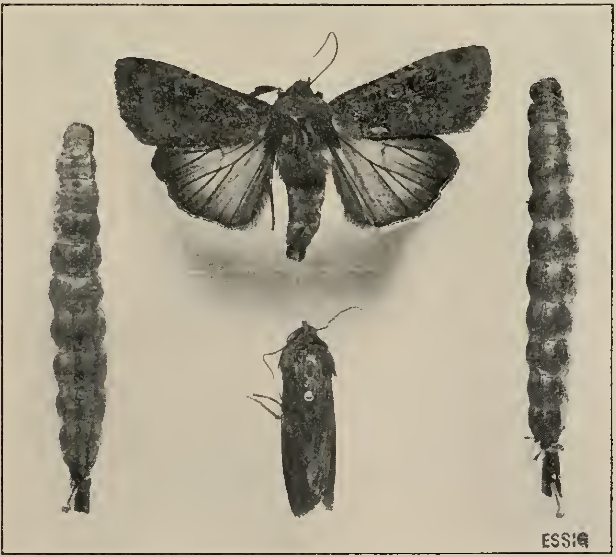

FIG. 149.—The common cutworm, *Peridroma margaritosa* var. *saucia* Hübn. (Original.)

Life History.—The small, white, ribbed, hemispherical eggs are laid in large irregular clusters, usually upon the stems of plants. The young worms begin to feed as soon as hatched and attack practically all vegetation, even burrowing into the ground and eating the roots and tubers, or gnawing the bark of trees. The pupal stage is passed in the soil, the chrysalis being rich brown in color and nearly an inch long. The winter is passed in this stage. The adults emerge early in the spring and begin egg-laying immediately.

Distribution.—This is one of the most common and important cutworms in this State, and occurs in all parts, being most abundant in the central and southern districts, but is also present in great numbers in the north.

Food Plants.—As stated above, this species works on practically every kind of vegetation including forage, cereal, root and truck crops, flowers and orchard trees, while wild plants share in furnishing it food.

THE POTATO TUBER MOTH.

Phthorimæa operculella Zeller (Family Gelechiidæ).

(Figs. 150-153.)

General Appearance.—The larvæ vary from white to slightly pink—the head being black. When full grown they are about one inch

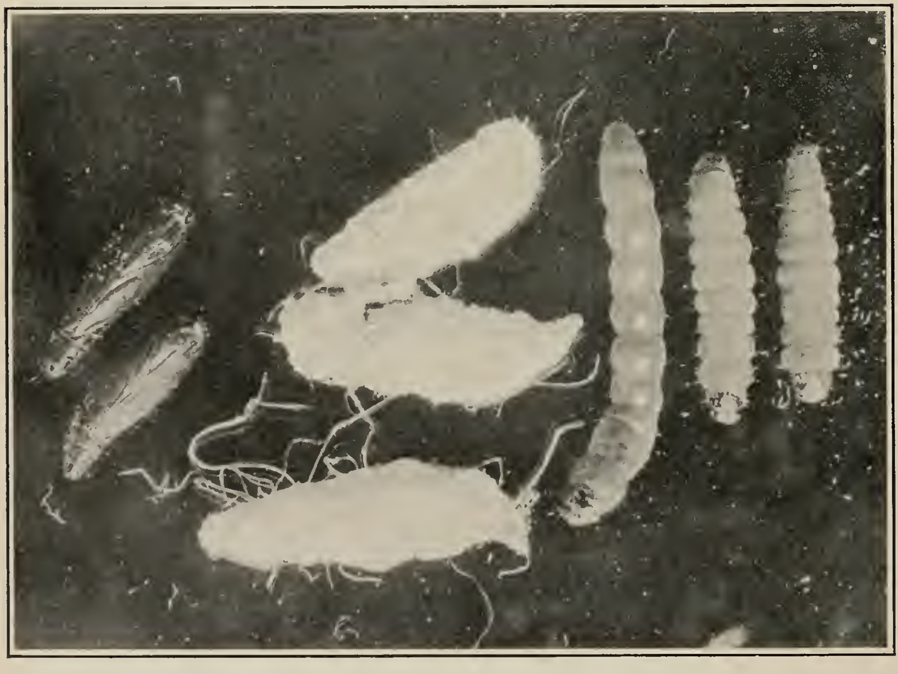

Fig. 150.—Potato tuber moth (*Phthorimæa operculella* Zeller). Larvæ on the left, cocoons containing chrysalids in the middle and the bare chrysalids on the right. Enlarged. (Essig, M. B. Cal. Hort. Com.)

long. The cocoon is spun of fine white web, the chrysalis being light brown in color and about three eighths of an inch in length. The wings of the adults are decidedly gray in color with the bodies silvery. They are about one inch long.

Life History.—The small pearly-white eggs are laid on the stems of growing potato plants or upon exposed tubers in early summer, or upon the tubers at digging time. Within fifteen days they hatch into caterpillars, which feed upon the leaves, stems or tubers, or only upon the latter when they are stored in bins. It requires from three to five weeks to mature, when it seeks a sheltered place and spins a cocoon, in which to pupate. During the winter the pupal period may occupy several months, but in the summer and fall from fourteen to twenty days are required. The adults are night flyers and are especially abundant in the fall, particularly when early potatoes are dug. If the tubers are exposed over night the females lose no opportunity to deposit their many eggs, generally over all of them, so as to make a serious infestation. The adults live but a few days.

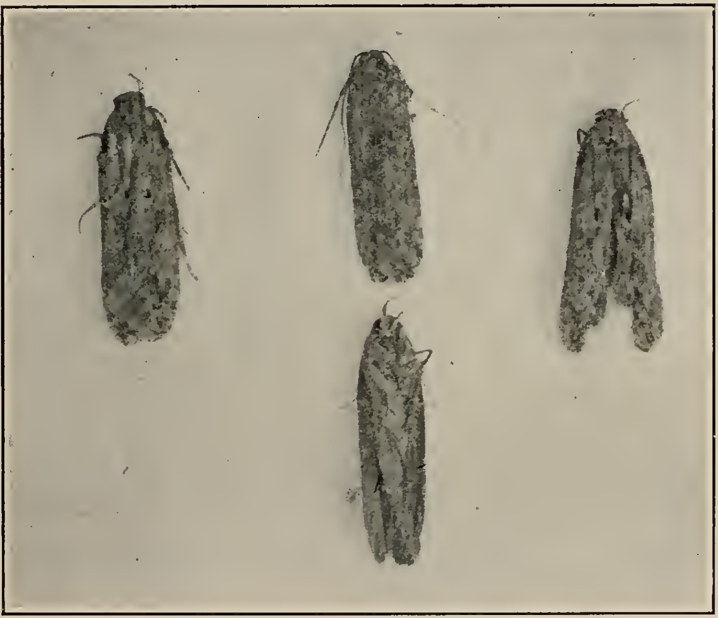

FIG. 151.—Adults of the potato tuber moth (*Phthorimæa operculella* Zeller) enlarged several times. (Essig, M. B. Cal. Hort. Com.)

Distribution.—Throughout the central and southern parts of the State.

Food Plants.—Potatoes, tobacco, nightshade, and cat-tails are attacked.

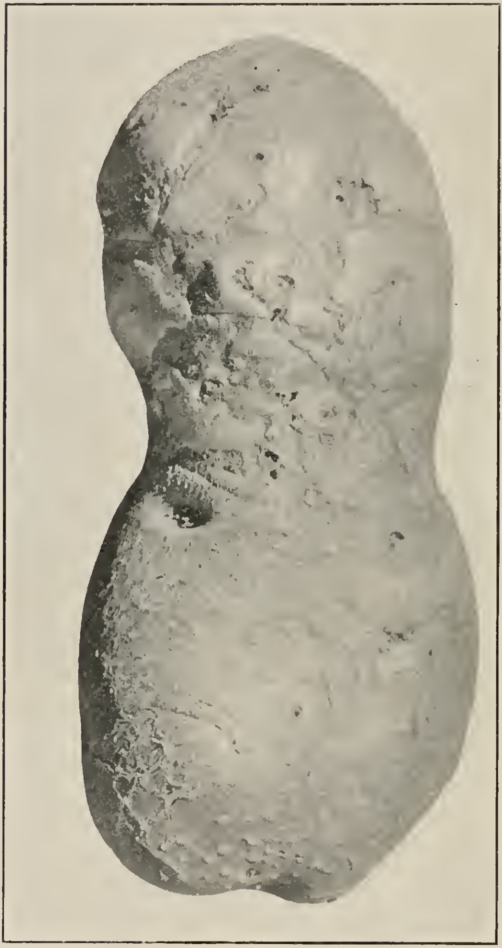

FIG. 152.—Work of the potato tuber moth (*Phthorimaea operculella* Zeller) on potato. (Essig, M. B. Cal. Hort. Com.)

Control.—All host plants should be kept from growing in or around the potato fields. Deep planting and hilling should be practiced to prevent access to the tubers. The potatoes should be dug as early as possible and not allowed to remain in the fields over night, unless sacked. In places of general infestations the tubers may be thoroughly disinfected before storing, by soaking them in water for thirty-six hours. In the storage bins, two pounds of carbon bisulfid to every one thousand cubic feet of air space will prevent injury, provided this is done four or five times, or as often as adult moths appear.

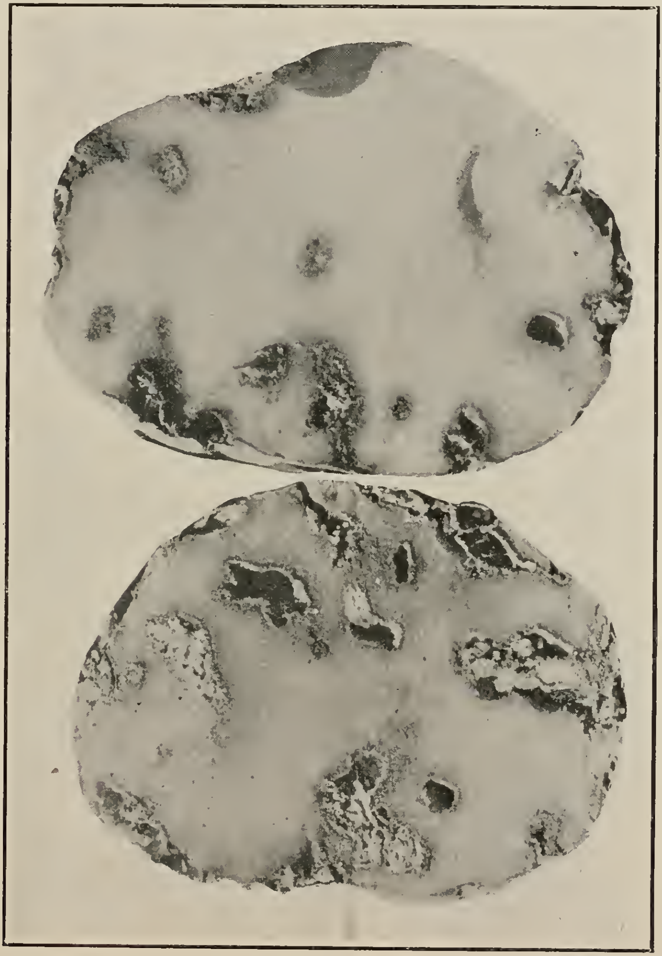

FIG. 153.—Cross-sections of potato, showing the interior work of the potato tuber moth. (Essig, M. B. Cal. Hort. Com.)

THE PEACH TWIG-BORER.

Anarsia lineatella Zell. (Family Gelechiidæ).

(Figs. 154-156.)

General Appearance.—The adults of this insect are seldom if ever observed by the average orchardist. They are small, between one fourth and one half inches long, and dark silvery gray in color. The presence of the larvæ is easily told in the spring by the dying-back of the young buds and twigs. The larvæ are small, scarcely more than one half an inch long when full grown. The color varies from pink or dusky white to dark brown or almost black. The cocoons are dark brown and are hid away in small protected places.

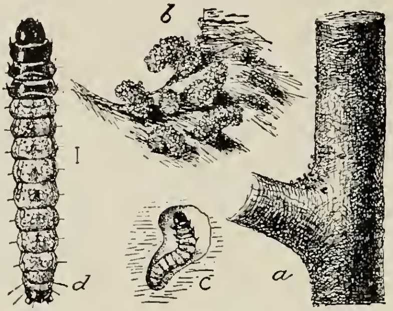

FIG. 154.—The peach twig-borer (*Anarsia lineatella* Zell.) in winter quarters. a, twig, showing in crotch minute masses of chewed bark above the larval chambers; b, same, much enlarged; c, larval cell enlarged; d, larva greatly enlarged. (U. S. Dept. of Agrcl.)

Life History.—The adults lay the eggs giving rise to the hibernating larvæ after August. These over-wintering caterpillars make minute burrows in the bark in which to hibernate. They are very small but their chambers are quite easily located by the minute piles of frass above (Fig. 154). In the spring as soon as the leaf buds open the larvæ leave their winter quarters and at once begin to bore into the new buds or shoots, completely killing them (Fig. 156). They often appear in such great numbers as to do much damage. They reach maturity about May and pupate in cracks or crevices of the bark. Their hiding places are easily located by a loose white web spun over the entrance by the larvæ before pupation takes place (Fig. 155). Within a week or so the adults emerge and deposit their eggs at the bases of the young shoots, the larvæ beginning to work upon them as soon as hatched. These summer caterpillars also bore into the fruit and cause much destruction in this way. They pupate in the fall and emerge as adults in time to deposit the eggs, giving rise to the hibernating young, which begin to appear in September. There are three generations a year—the hibernating winter brood and two summer broods.

Distribution.—Throughout the entire State, excepting in the northern coast counties where peaches are not grown extensively. Particularly harmful in the Sacramento and San Joaquin valleys.

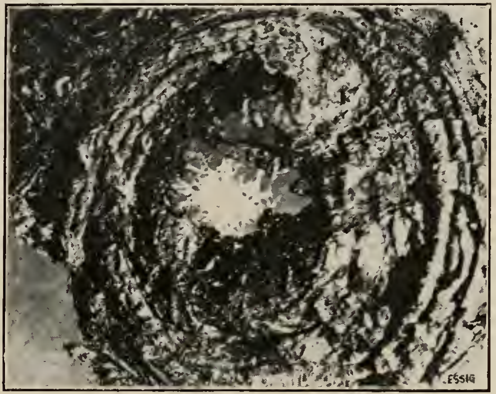

FIG. 155.—The web spun across the chamber occupied by the pupa of the peach twig-borer in summer. This web is spun by the larva and is a quick and sure way of locating the pupa. (Original.)

Food Plants.—The larvæ work in the early spring upon the young buds and shoots and during the summer on these, and on the fruit. The twigs are also attacked. In all cases the larvæ enter near the tip and work toward the base. During the early spring the young starting buds are often killed before they are more than two inches long. In attacking the fruit they enter at the stem end and may work completely around the pit, thus causing rapid decay and complete ruin.

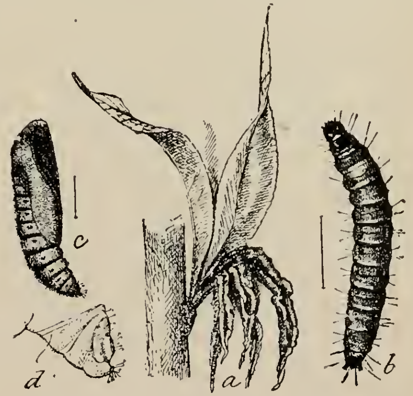

FIG. 156.—The peach twig-borer. a, new shoot killed by larva early in the spring; b, larva; c, pupa; d, tip of same. All enlarged. (U. S. Dept. Agrcl.)

Control.—Though once a most serious pest, control methods have been perfected which make it no longer a menace to the peach grower. These consist of a thorough application of lime-sulphur spray when the blossoms begin to open. Spraying when the trees are in full bloom is preferable to an application before the blossoms begin to appear. The commercial preparation diluted one part to ten of water and applied as a strong spray under a pressure of from 150 to 200 pounds is found to give excellent results. Mr. Chas. B. Weeks, horticultural commissioner of Tehama County, has been using this formula for a number of years and finds it satisfactory in every way.

THE ANGOUMOIS GRAIN MOTH.

Sitotroga cerealella Oliv. (Family Gelechiidæ).

(Fig. 157.)

General Appearance.—The adult females are light-yellowish, iridescent brown with few darker markings on the fore wings. They average about one inch in length, including folded wings. The very small eggs are oval elongate and slightly pinkish in color. The larvæ are scarcely over one fourth of an inch long but more often small enough to comfortably occupy the inside of a wheat or barley kernel. They are robust and white. The pupæ are pale yellowish-brown.

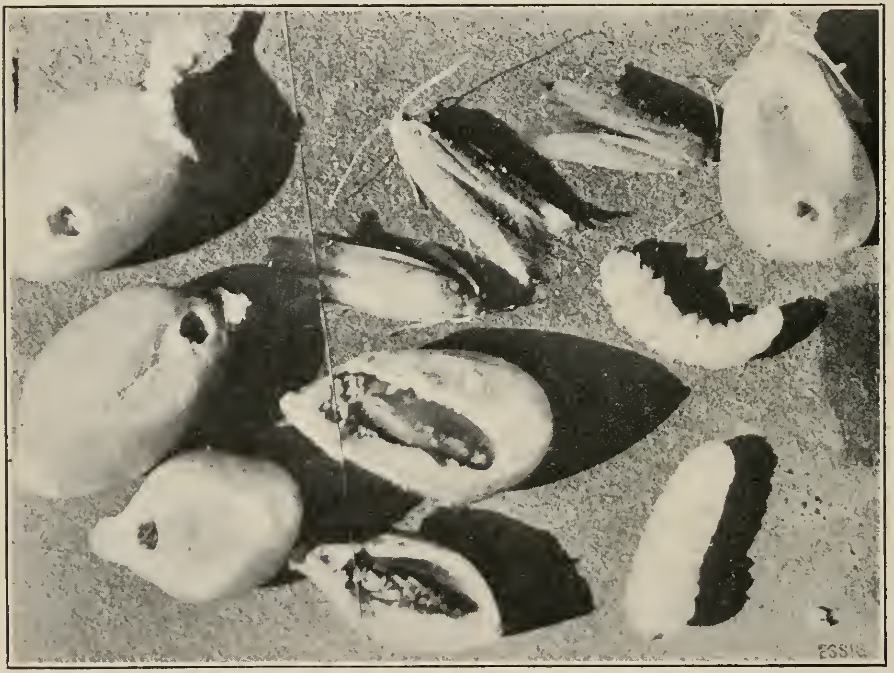

Fig. 157.—The angoumois grain moth (*Sitotroga cerealella* Oliv.), showing larvæ, pupæ, adults and the work on kernels of popcorn. (Original.)

Life History.—In grains, the eggs are deposited on the outsides of or between the kernels in the head or on the cob. They are laid in the field in late summer and fall, but in storehouses egg-laying may continue throughout the year. As soon as the young hatch they bore a very minute hole and work their way into the interior of the kernel. In wheat and barley only one individual occupies the interior, while in corn there may be several or many. The larval and pupal stages are passed within the kernel, which is completely destroyed. The adult insect emerges through a small circular hole cut in the thin wall and escapes to mate, soon to start other broods. The life cycle occupies about forty days, there being many overlapping broods a year. In bins of grain, breeding is very rapid and great destruction is wrought in a very short time.

Distribution.—Throughout the southern part of the State.

Food Plants.—This is primarily a grain pest, attacking the kernel and completely destroying the inside. Corn, wheat and barley are infested.

Control.—Crops should be harvested as soon as possible to prevent infestation in the field. After they have been stored is when the greatest damage may be done before the presence of the pest is known. Fumigation with carbon bisulfid as soon as any adults appear is the best remedy.

THE LIMA BEAN POD-BORER.

Etiella zinckenella (Treit.) (Family Pyralidæ).

(Fig. 158.)

General Appearance.—The adult moths are gray with ocherous blotches on the fore wings. There is a plain, broad, white band along the margins of these wings and an ocherous band with brown spots across the inner fourth. This band is especially conspicuous. The hind wings are light gray. The moths are small, scarcely more than

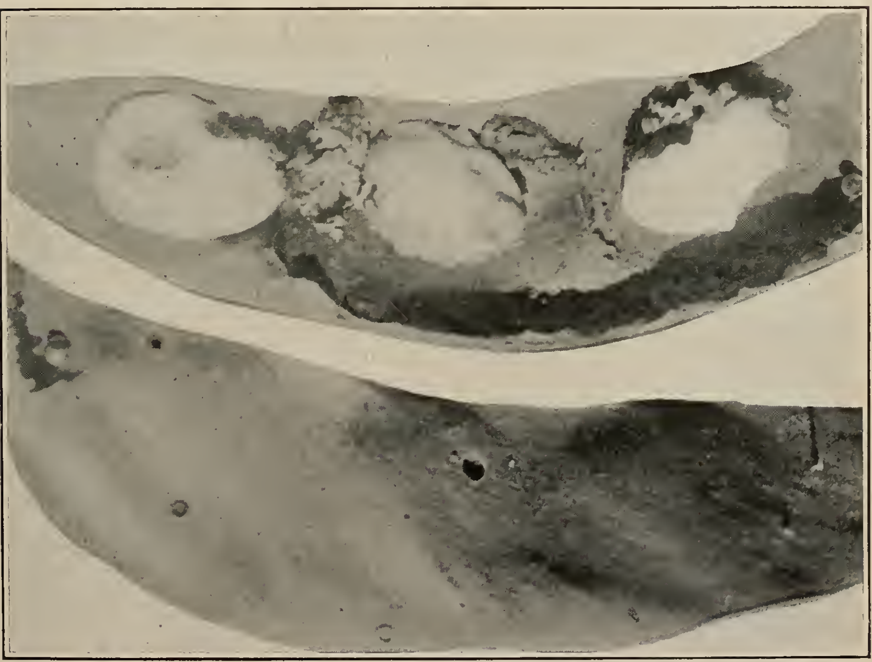

FIG. 158.—The work of the lima bean pod-borer, *Etiella zinckenella* (Treit.), on bush lima beans. (Original.)

one half inch long. They are exceedingly active on wing and foot. The pupa is rich brown and usually enclosed in a thin white cocoon. The young larvæ are white or light green. When full grown they are white or distinctly reddish above and greenish beneath. The head is dark as is also the prothoracic plate and the legs. They average about one inch in length. When disturbed they wriggle violently.

Life History.—The writer has never seen the eggs so is unable to state where they are deposited, but judging from the observance of their work they are probably laid upon the bean plants and the pods as soon as they are formed. As soon as hatched the young caterpillars bore through the pods and begin feeding upon the beans inside, all of which are usually gnawed into or destroyed before fully developed. When ready to pupate the larvæ either do so in the pod or select some other place. Very often they crawl into the ground and pupate under clods or any convenient shelter. As a protection a thin white cocoon is spun. In this stage some of the insects hibernate though many appear as adults in late summer and fall. There is but one brood a year. The adults appear in the spring about May.

Distribution.—Most of the records concerning this pest have come from the southern part of the State where it is apparently well established. As early as 1885 Albert Kœbele collected it in El Dorado County, and it probably occurs in limited numbers in the central part as well. The moth is probably of European or Asiatic origin, having been imported into this county.

Food Plants.—The beans in the pods of the small bush lima beans are the favorite food for this moth, though it occasionally attacks those of the large limas. This has been observed in Ventura County, but is not common there.

Control.—Early beans are the ones suffering from the attacks of the caterpillars, though the latter plantings do not escape. As the bush-lima is usually the only crop attacked it would be well to plant the large and later varieties instead.

THE ORANGE TORTRIX.

Tortrix citrana Fern. (Family Tortricidæ).

(Figs. 159, 160.)

General Appearance.—The adult insects are gray in color and hardly one half inch long. The eggs are cream-colored, circular, flat and covered with fine mosaic-like markings. They are laid so as to overlap like the scales of a fish. The larvæ when full grown vary from one half to three quarters of an inch in length and are white or dusky in color. The chrysalids are brown.

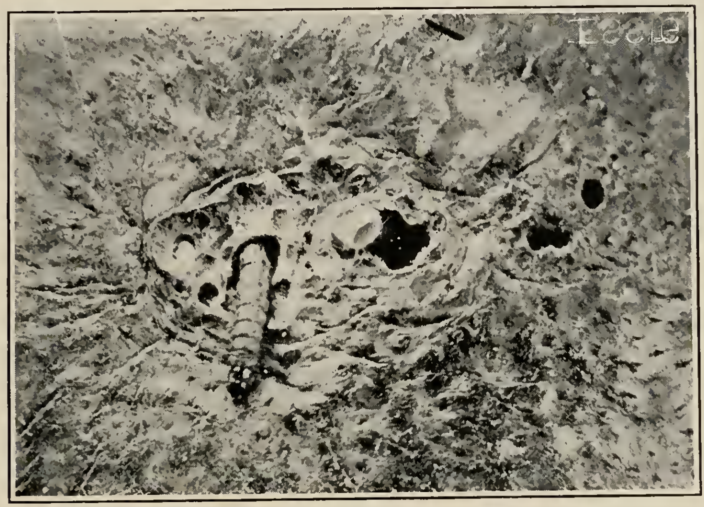

FIG. 159.—The larva of the orange tortrix (*Tortrix citrana* Fern.) emerging from a burrow in an orange. Other burrows are also visible. (Original.)

Life History.—The eggs are laid in clusters in early spring, usually upon the undersides of the leaves, each moth depositing about fifty. The larvæ hatch in about two weeks and feed upon the surface of the orange fruit or upon the foliage or tips of the shoots of the other hosts. Burrows are also made in the fruit, especially throughout the peel, thus causing decay and ruin. The young reach maturity in about two months. The

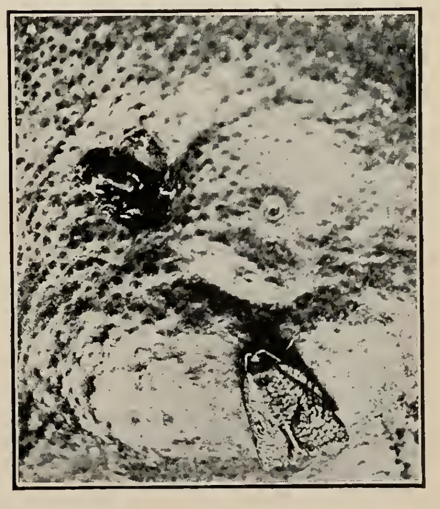

FIG. 160.—The adult of the orange tortrix (*Tortrix citrana* Fern.) near entrance of larval burrow. (After Quayle. Courtesy Cal. Exp. Sta.)

pupal stage is passed within the old burrow or any protected place outside. The adults emerge in from one to two weeks. The broods overlap, but there are probably three generations a year.

Distribution.—Common throughout the citrus growing sections of the southern part of the State.

Food Plants.—The greatest damage is done to the fruit of the orange, by making burrows throughout the peel and often into the pulp. According to H. J. Quayle the larvæ also work upon the foliage of the apricot, willow, oak, wild walnut, goldenrod and many greenhouse plants.

Control.—Though the destructiveness to oranges has been quite great in a few instances, yet not enough actual damage has been done to warrant the application of poison sprays or other methods necessary for control. The parasitic braconids which work upon the larvæ no doubt play some part in the subjection of the pest.

Natural Enemies.—The tachina fly (*Phorocera parva* Bigot.) has been reared from this tortrix at Los Angeles. Internal braconid parasites also work upon it.

THE CODLING MOTH.

Cydia pomonella (Linn.) (Family Tortricidæ).

(*Carpocapsa pomonella* Linn.)

(Figs. 161, 162.)

General Appearance.—The eggs are small, flattened to oval in shape, and not larger than a pinhead. When freshly laid they are pearly white. The larvæ or so-called "worms" are very minute when first hatched but when full grown are nearly an inch long. They are usually pinkish above and whitish underneath. The cocoon is made of white silk and is usually hid away in some sheltered place. The pupa, scarcely over one half inch long, is first yellowish, turning with age to a dark rich brown. The adult moths are small being much less than one inch long with a wing expanse seldom greater than three fourths of an inch. The fore wings are grayish brown with several gray or lighter cross lines. Near the tip of each is a small brown spot in which two irregular golden lines appear. The hind wings are slightly lighter than the fore wings, with fringed borders. The color harmonizes well with the gray bark of the apple trees.

Life History.—The winter is passed in the larval stage upon the trees, in such protected places as under the bark, in split holes, crotches, etc., or beneath trash or litter on the ground, as well as in storehouses where the larvæ have escaped from stored fruit. In the spring they spin their whitish cocoons and enter the pupal stage, which occupies about twenty days. The first adult moths are ready to emerge about the time the apples bloom and many continue to appear throughout the spring and summer. The first to appear oviposit mainly upon the leaves and twigs, very few eggs being laid upon the fruit. The eggs of the second generation are usually placed upon the fruit. The larvæ hatching from the first eggs usually begin to work immediately upon the leaves while those of the second generation gain entrance to the fruit almost immediately at the calyx end. It requires about twenty days for the larvæ to mature. The generations overlap greatly throughout the summer. Adults appear about the middle and in a few days begin egg laying. The entire life cycle occupies nearly fifty days, there being two broods each year in the Western States.

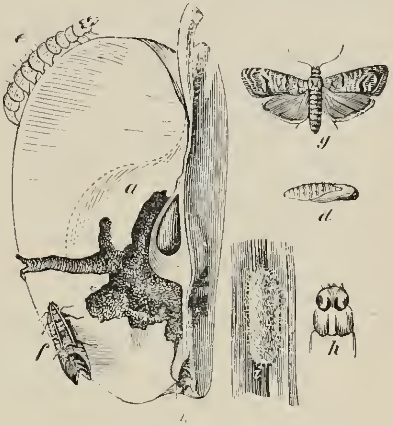

FIG. 161.—The codling moth, *Cydia pomonella* (Linn.). *a*, apple cut to show the borings of the larva; *b*, place where the egg was laid and the larva started; *d*, pupa; *e*, larva; *f* and *g*, adult moths; *h*, head of larva; *i*, cocoon. (U. S. Dept. Agrcl.)

Distribution.—In all parts of the State, excepting the northern coast counties and even these are not entirely exempt.

Food.—All varieties of the fruit of apples and pears.

Control.—The accepted treatment for this pest is spraying with arsenical sprays. The first application should be made just as soon as the petals of the blossoms fall and the sepals of the calyx are open (Fig. 162). It will be difficult to find a time when all of the calyx cups are the same, but work should be started as soon as possible, and the entire orchard sprayed within a few days. Thorough work with high pressure and

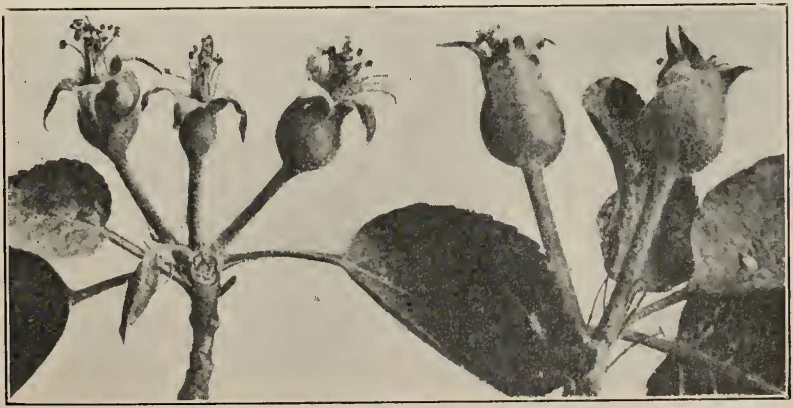

FIG. 162.—Young apples at the left are just right to spray for the codling moth, the calyx lobes being extended and open, while the apples at the right are too mature, the lobes being closed and too late to treat for codling moth. (After Quaintance.)

liberal application usually make one spraying sufficient for the control of the pest in this State and two are seldom necessary. However, in cases where the first spraying is not sufficient a second application should be made at from three to four weeks later. It is a common practice to combine Bordeaux mixture with the arsenical sprays to control fungous diseases, such as scab, with the one application.

Natural Enemies.—So far natural control of the codling moth has proven very unsatisfactory. Through Mr. George Compere the State has secured a hymenopterous parasite (*Calliephialtes messor*). which preys upon the larvæ just after the cocoons are spun. This parasite may be secured from the State Insectary.

THE CALIFORNIA TUSSOCK MOTH.

Hemerocampa vetusta Boisd. (Family Liparidæ).

(Figs. 163-165.)

General Appearance.—The eggs are small, oval, white and are laid in closely woven clusters, usually upon the old female cocoon. The clusters or egg masses are nearly spherical, grayish brown in color and between one fourth and three eighths of an inch in diameter. The full

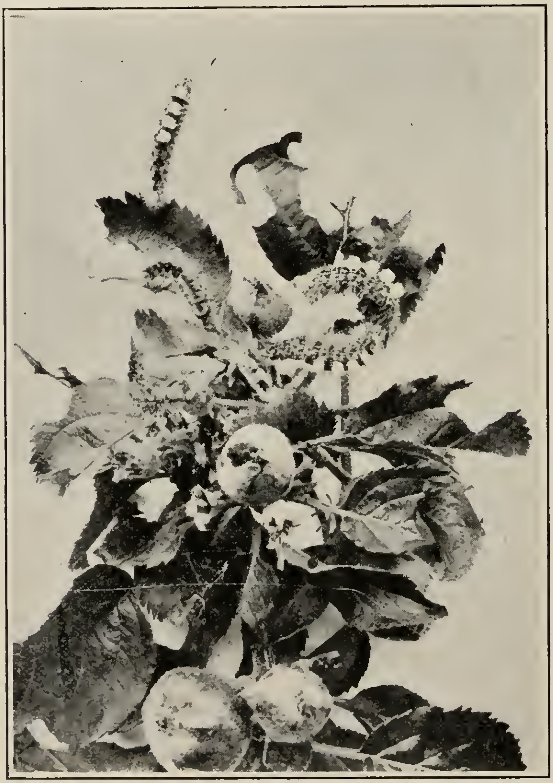

FIG. 163.—The caterpillars of the California tussock moth (*Hemerocampa vetusta* Boisd.) on apple. (After Volck.)

grown larvæ or caterpillars vary from one and one half to two inches in length. They are generally gray in color with numerous colored spots and many tufts, consisting of four prominent white ones on the dorsum and two distinct black tufts or horns on the head and one near the posterior end. The adult females are wingless and light silvery-gray in color. The males are winged and gray in color.

Life History.—The eggs are deposited by the freshly emerged females during the months of May, June and July. The caterpillars upon hatching begin to feed upon the young fruit and foliage and continue their depredations for from forty to sixty days, when they spin cocoons singly or in large colonies. The moths emerge the following spring, mate, and the females begin egg laying. The winter is passed in the egg stage.

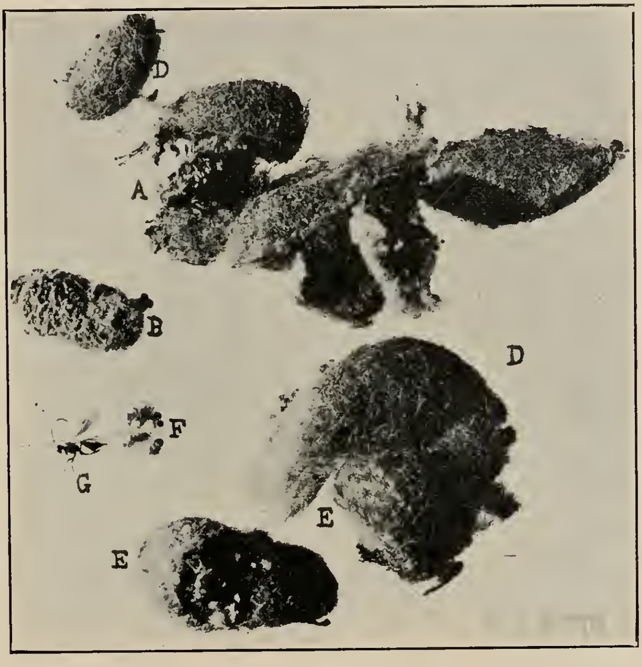

Fig. 164.—The California tussock moth. A and B, adult wingless females; D, cocoons; E, egg masses attached to the cocoons; F, eggs; G, internal parasite working upon cocoons. (Original.)

Distribution.—Occurs throughout the central part of the State, especially along the coast.

Food Plants.—The principal food of this insect is the foliage or young fruit of the apple, but it also feeds upon live oak, the yellow perennial lupin, cherry and walnut.

Control.—Spraying with poison sprays have proven unsatisfactory, due to the fact that the caterpillars are able to eat large doses without apparent injury. Hand picking of the egg masses has been followed with considerable success in the Pajaro Valley. This is done during the winter months, after the leaves have fallen. Great care must be exercised in getting all the egg masses, to insure profitable results. The eggs should be destroyed by immersing in oil or by burning.

When the caterpillars are on the trees great numbers may be removed by jarring. Bands around the tree trunks, such as are recommended for cankerworms, will keep those jarred off from again ascending the trees. In addition to the cotton and tanglefoot bands, Volck recommends a rope saturated with tanglefoot, or crude oil rich in asphaltum and tied around the trunks, while bands soaked in a mixture of equal parts of pine tar and molasses have given satisfaction.

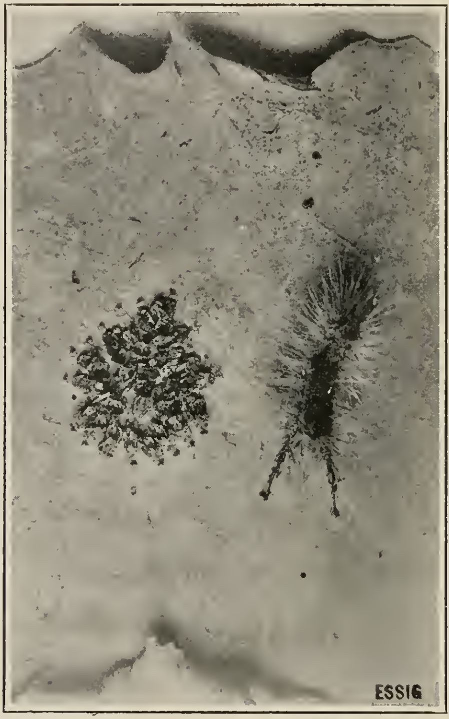

FIG. 165.—Dead caterpillar of the California tussock moth moved to show the pupa cases of internal parasites, which after killing it pupated underneath the dead body. (Original.)

Steep earth cones around the bases of the trunks may prove satisfactory in keeping the caterpillars from reaching the foliage.

Natural Enemies.—Mr. B. B. Whitney has succeeded in breeding three distinct hymenopterous parasites from the larvæ and pupæ. In addition to these there is the egg parasite (*Telenomus orgyiæ*). A dermested beetle also works upon the eggs. The tachina fly (*Tachina mella* Walk.) preys upon this species and has been bred out in large numbers from the masses of young and pupæ.

THE EASTERN APPLE-TREE TENT CATERPILLAR.

Malacosoma americana Fab. (Family Lasiocampidæ).

(Fig. 166.)

General Appearance.—The eggs are cylindrical to oval in shape and are laid in compact clusters around the smaller twigs so as to form a cylindrical-shaped mass over which the female spins a dark waterproof web. The caterpillars hatch in the spring and begin work upon the tender leaves and shoots, but rarely become abundant until early summer. When full grown the caterpillars are hairy, about one and three quarters inches long, black in color with distinct yellow and white stripes along the back and with blue and white dots along the sides. The cocoons are spun of yellow silk and the pupæ are rich reddish brown. The adults are about one inch long with a wing expanse of from one and one tenth to one and one half inches. The general color is purplish brown, the front wings having two white bands which are parallel to the wing margin and each other. The hind wings are plain.

Life History. — The winter is passed in the egg stage, the young caterpillars hatching out in the spring after the leaves begin to appear, but may sometimes be found on the trees before the blossoms are gone. The caterpillars attack the foliage. They are social in their habits and soon spin a large web on which they collect when not feeding. When ready to pupate the larvæ seek some sheltered place near the host,

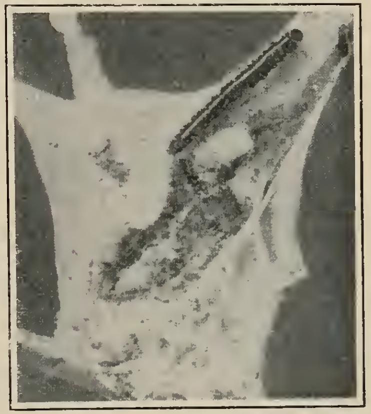

FIG. 166.—The nest of the apple-tree tent caterpillar, *Malacosoma americana* Fab. (After Moore.)

Distribution.—Limited to few localities. Probably imported on eastern nursery stock.

Food Plants.—Apple, cherry (cultivated and wild), plum and peach, the foliage and young fruit being attacked.

Control.—Destroying the egg masses during the winter months is one method of getting rid of the pest, but the usual arsenical sprays for codling moth or canker worm are sufficient to keep it in check.

The tents may be destroyed by burning with an asbestos torch when the young congregate in them.

THE WESTERN APPLE-TREE TENT CATERPILLAR.

Malacosoma disstria Hübn. (Family Lasiocampidæ).

(Figs. 167, 168.)

General Appearance.—In general appearance this species resembles the eastern apple-tree tent caterpillar (*M. americana*) in all stages.

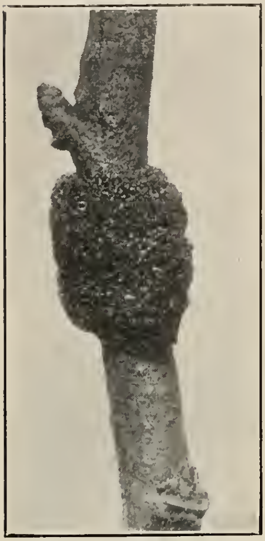

Fig. 167.—Egg masses of the western apple-tree tent caterpillar. (Original.)

Life History.—The life history is also like that of the eastern species, except that it collects in great colonies upon the trunks and larger limbs of the trees instead of making tents as does its eastern relative.

Distribution.—Throughout the central and northern parts of the State.

Food Plant.—The foliage and young fruit of apple trees.

Control.—Practically the same as for the eastern form, except that burning is not as efficient for the California species. When disturbed, most of the caterpillars fall to the ground and may be kept from again reaching the tree by a suitable band around the trunk. Colonies on the trunks are easily and quickly killed by a liberal application of strong whale-oil soap with a large brush. Strong poison sprays are also recommended as soon as the larvæ begin to appear.

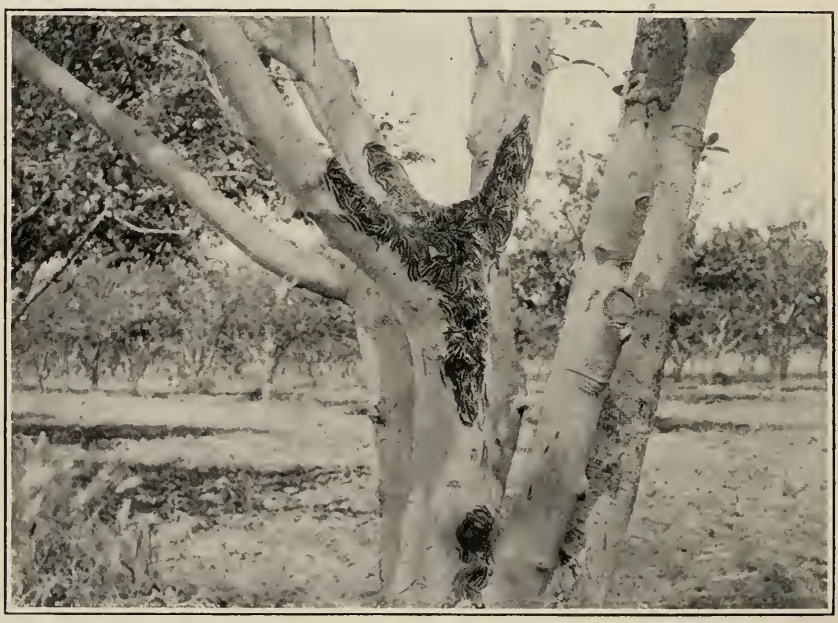

Fig. 168.—The Western apple-tree tent caterpillar (*Malacosoma disstria* Hübn.). Caterpillars in a characteristic group on an apple tree. (Original. Cal. Hort. Com.)

THE BROWN DAY MOTH.

Pseudohazis eglanterina Boisd. (Family Saturniidæ).

(Figs. 169, 170.)

General Appearance.—The eggs are salmon-colored and laid in clusters around small stems or branches, as shown in Fig. 169. The larvæ are dark or nearly black with fine lateral, red stripes and spots on the dorsum. The bodies are covered with long tufts of black and light-brown hairs. When full-grown they are a little over two inches long. The chrysalids are dark reddish-brown and about one inch long. The adults are beautiful yellow moths blended with red or salmon color and regularly marked with black. The wing markings are shown in Fig. 170. The thorax is deep orange; the dorsal half of the abdomen is yellow and the ventral half red. A black band encircles each segment. The posterior end has a long tuft of yellow and red hairs. The antennæ of the female are orange, and brown in the male. The legs are yellow with black spines.

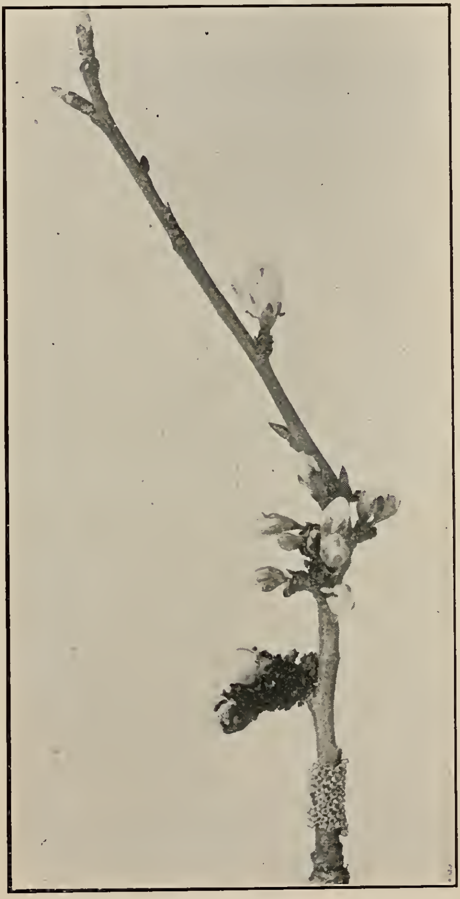

Fig. 169.—Eggs and young caterpillars of the brown day moth (*Pseudohazis eglanterina* Boisd.). The caterpillars are shown in a characteristic colony attacking the lowest prune bud. (U. S. Dept. Agrcl.)

Life History.—The eggs are deposited in the spring of the year upon various fruit trees, wild trees and bushes. The young attack the foliage, almost entirely defoliating the plants. When full grown the larvæ seek the ground where they pupate and thus pass the winter, emerging early in the spring as adults. These are often seen flying during the day.

Distribution.—Throughout the entire State, but more abundant in the Sierra foothills and in the Sacramento and San Joaquin valleys.

Food Plants.—This species attacks a great variety of both wild and cultivated trees and shrubs. Prune trees have often been severely attacked, the young larvæ destroying the first appearing buds.

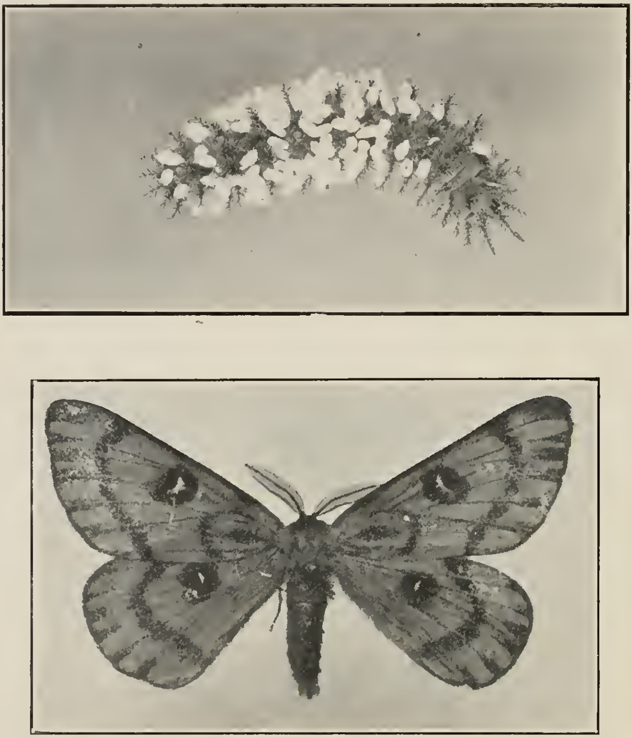

Fig. 170.—The brown day moth (*Pseudohazis eglanterina* Boisd.). Larva covered with cocoons of an internal parasite and the adult male. (Larva after U. S. Dept. Agrcl. Adult original. Cal. Hort. Com.)

Control.—The egg masses are very conspicuous and great numbers of them may be easily destroyed by hand picking in the spring.

Arsenical sprays applied when the larvæ become apparent are also effective.

Natural Enemies.—Internal humenopterous parasites perform a very important rôle in checking the ravages of this pest. Caterpillars are often found with the cocoons of these parasites attached to the bodies as shown in Fig. 170. The eggs are also destroyed in large numbers by small parasites.

THE SPRING CANKERWORM.

Palcacrita vernata Peck (Family Geometridæ).

(Figs. 171, 172.)

General Appearance.—The larvæ are dark olive-green, brown or nearly black, very slender and about one inch long. Because of their looping method of traveling they are often called measuring worms. In this species they possess but two pairs of legs on the under side of the posterior half of the body. The cocoon is composed of tough silken web, which is not easily broken. The pupa is grayish brown. The female is wingless and covered with soft gray down. The male is winged and gray in color. The eggs are regularly oval.

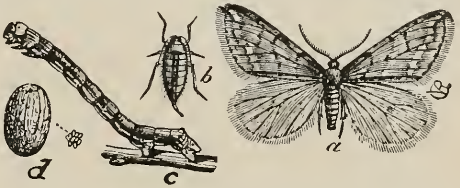

FIG. 171.—The spring cankerworm (*Paleacrita vernata* Peck). *a*, adult male; *b*, female; *c*, larva; *d*, egg enlarged and in egg-mass. (After Riley.)

Life History.—The female of the spring cankerworm oviposits in the spring before the buds of the apple trees start. The eggs are laid singly or in irregular masses in crevices or under the bark-scales on the limbs, trunks, twigs or leaves. The young cankerworms hatch out just in time to begin destroying the first young leaves. They often occur in such numbers as to almost entirely defoliate the trees and cause great loss. After they mature they drop to the ground and pupate in a cocoon, just beneath the surface, where they hibernate through the winter, and the adults appear early the next spring. There is but one generation each year. The females, not having wings, must crawl up the trunk in the spring to deposit their eggs in suitable places during March and April.

Distribution. — Throughout the apple-growing sections of the central part of the State.

Food Plants.—Apples, apricots, cherries, prunes, the foliage being attacked.

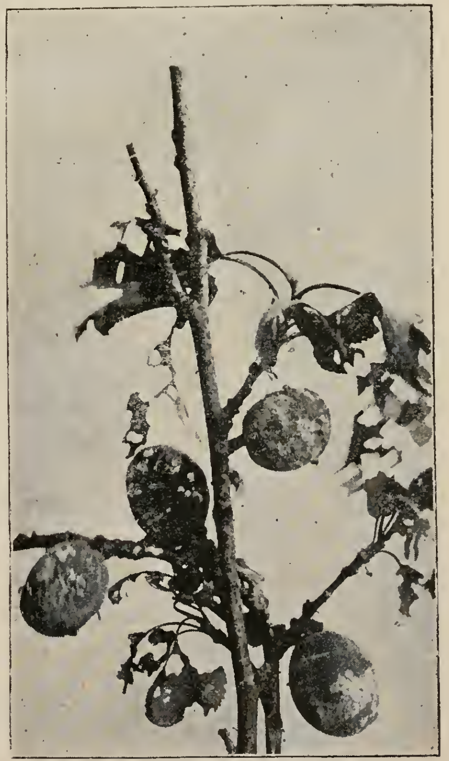

FIG. 172.—Work of cankerworms on apricot. (After Craw.)

Control.—Inasmuch as the female is wingless the spread of this pest is not very rapid and control is not so difficult as is the case with many of the orchard caterpillars. The female must crawl up the tree trunk in the early spring to oviposit and any methods adopted to prevent this will reduce subsequent injury by the pest. Bands of adhesive paper or cotton around the trunks have proven effective, while one of tree tanglefoot, about two inches wide, has been satisfactory. Any of these devices will cause the females to oviposit below the bands and the young can be easily and readily killed with a soap wash. The bands should be made about the first of March.

In cases where the young caterpillars are already on the trees or where the above methods have not kept them from the foliage, arsenical sprays should be applied.

Plowing and harrowing close to the trees in the fall during September or October will crush great numbers of the pupæ in the cocoons and aid in reducing the next spring's broods.

Natural Enemies.—The eggs are parasitized by calcid flies and preyed upon by mites, while birds, ichneumonid parasites, tachina flies and predaceous beetles prey upon the larvæ.

THE FALL CANKERWORM.

Alsophila pometaria Harris (Family Geometridæ).

(Figs.173, 174.)

General Appearance.—In all of its stages this insect greatly resembles the spring cankerworm (*Paleacrita vernata* Peck), but differs in that the larvæ have three pairs of legs on the posterior half of the body instead of two and the bodies are more distinctly striped. The primary wings of the males also have an extra light band near the middle. The eggs are shaped like small flower pots, being smaller at the bottoms than at the tops, with distinct darker circles at the tops (Fig. 173 *c* and *d*). They are deposited in regular clusters of from fifty to two hundred, standing side by side in exposed places.

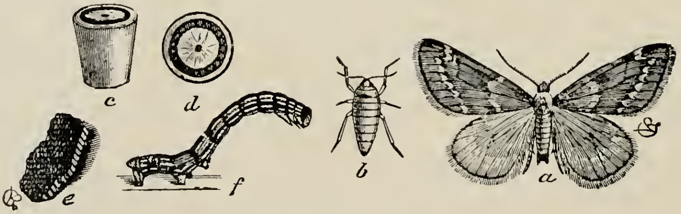

FIG. 173.—The fall cankerworm (*Alsophila pometaria* Harris). a, adult male; b, adult female; c, side and d, top view of egg; e, egg-mass; f, larva or cankerworm. All natural size except c and d. (After Riley.)

Life History.—The life history is practically the same as that of the spring cankerworm, but the eggs are deposited in a compact mass and glued to the twigs and covered with hairs from the female's body in the late fall or during the milder portions of winter, as late as March. The young hatch about the same time as those of the spring forms and work about the same. The adults issue from October to December, or as late as spring, and immediately crawl up the trunks to deposit their eggs.

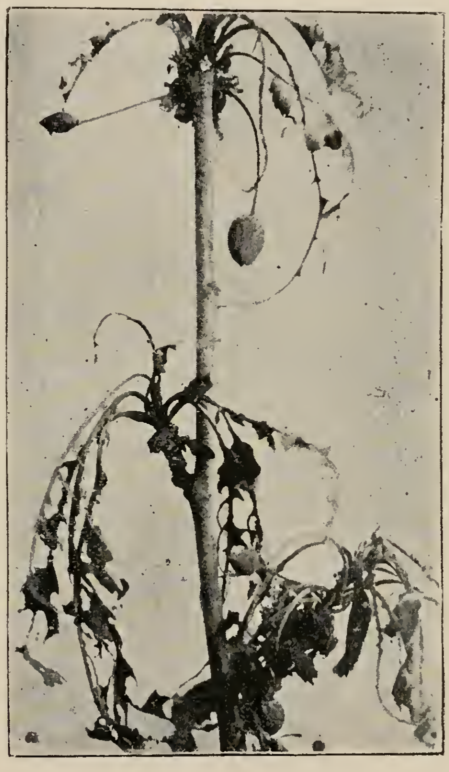

FIG. 174.—The work of cankerworms on cherry. (After Craw.)

Distribution.—Found in the central and northern parts of the State.

Food Plants.—The foliage of the apple, prune, cherry, apricot and other fruit trees are attacked.

Control.—Control measures as adopted for the spring cankerworm may be used for this. Bands around the tree trunks will not prove as effectual, because of heavy winter rains, unless they are occasionally renewed. These barriers must be put in place during September and October and continued until spring.

Natural Enemies.—The species is subject to the same natural enemies as is the preceding insect.

THE RED-HUMPED CATERPILLAR.

Schizura concinna S. & A. (Family Notodontidæ).

(Fig. 175.)

General Appearance.—The full grown caterpillar is covered with black tubercles, which makes it appear dark. The body is alternately lined with white and black stripes along the back and with waved black and yellow stripes along the sides. The head is bright red as is the fourth segment (first abdominal segment), which is also larger than any other segment, and has a distinct hump, on the top of which are four prominent black spines or tubercles. From this hump the name is derived. The length varies from one and one fourth to two inches when ready to pupate. The pupa varies from tan to dark-brown in color and is scarcely one inch in length. The adults are very plain brown or grayish moths and are seldom, if ever, seen by the grower.

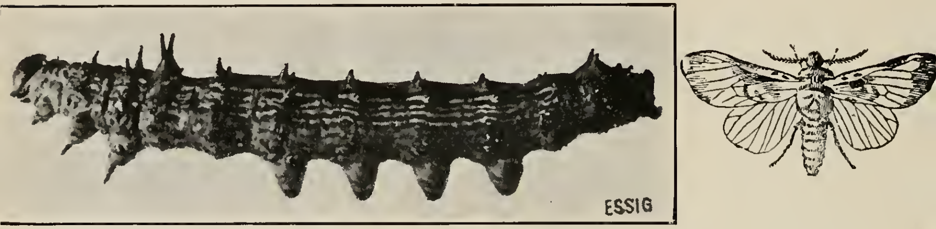

Fig. 175.—The red-humped caterpillar (*Schizura concinna* S. & A.). Larva, much enlarged (original), and adult. (Cal. Hort. Com.)

Life History.—The eggs are deposited upon the leaves after the trees have put forth a good growth in early summer—May and June. The young caterpillars are thickest during June and July but may continue to appear until late in September, showing that eggs are often laid quite late. Their work consists in destroying the foliage, the midribs of the leaves being all that usually remain. They work rapidly and thoroughly, making the attacks easily discovered by a careful observer. Late in July and during the months following many of the larvæ become full grown and drop to the ground, where they spin a thin cocoon and transform. The cocoons are located from one to three inches under the surface of the ground, among the thickly fallen leaves, or in the grass if it is allowed to grow in the orchard. The winter is passed in the pupal stage, the adults emerging in the spring to oviposit after the foliage is well out.

Distribution.—In the central part of the State.

Food Plants.—Apple, hawthorn, prune, plum and cherry are attacked, and much damage is often done to these trees because of the destruction of the foliage by the large colonies of caterpillars.

Control.—Entire colonies may be exterminated by hand picking, which is especially recommended for small trees. In large orchards where this is impossible, arsenical sprays should be used. Hoeing or cultivating close to the trees in the fall and winter will kill many of the wintering pupæ.

THE SPOTLESS FALL WEB-WORM.

Hyphantria textor Harris (Family Arctiidæ).

(Fig. 176.)

General Appearance.—The adults are slightly over one half inch long with a wing expanse of one and one half inches. The body is light and the wings pure or dusky white. There are no spots upon wings or body. This species is distinguished from the fall webworm (*Hyphantria cunea* Drury) of the Eastern States by the pure white antennæ and the absence of spots on the abdomen. The full grown larvæ are very hairy, yellowish or greenish in color, with a darker stripe along the back, a yellow stripe along the side and covered with whitish hairs which arise from black and orange-yellow tubercles.

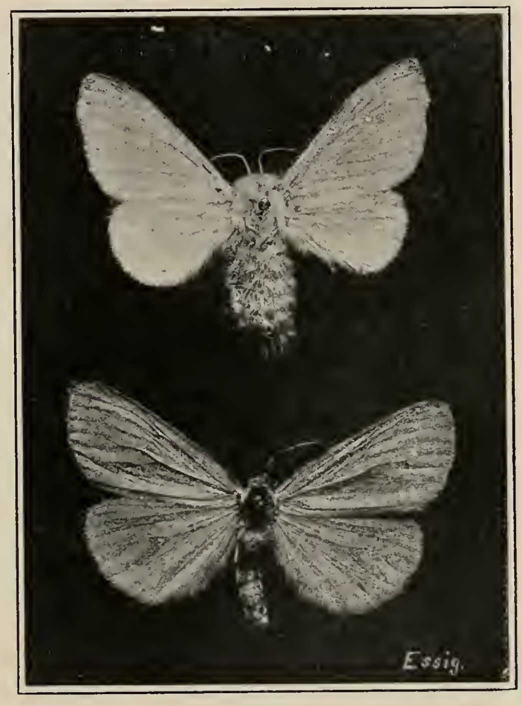

FIG. 176.—The spotless fall webworm (*Hyphantria textor* Harris). Top, female; bottom, male. Enlarged. (Original.)

Life History.—This species hibernates in the pupa stage within a cocoon attached to tree trunks, fences, rubbish or under the ground. The moths emerge in the spring, mate and during the nights the females deposit from four hundred to five hundred eggs in clusters upon the leaves of the food plants. The caterpillars feed in colonies and spin webs large enough to accommodate all the members which may include a large limb of a tree. When full grown the larvæ leave the web and descend to suitable pupal quarters. There are two broods a year, the second appearing late in the summer.

Distribution.—Common throughout the Sacramento and San Joaquin valleys and is the webworm most often encountered.

Food Plants.—This species feeds upon the foliage of a great number of wild and ornamental trees and shrubs, as well as upon fruit trees. During the past year much damage was done to willows in the San Joaquin Valley, while peach trees suffered in Sutter County.

Control.—The application of arsenical poisons, the collecting of the cocoons and the burning of the nests or webs containing the larvæ with a torch are the remedies used against this pest.

Natural Enemies.—Internal parasites play a very important part in the control of this moth.

THE STRAWBERRY CROWN MOTH.

Sesia rutilans (Edw.) (Family Sesiidæ).*

(*Synanthedon rutilans* Edw.)

(Fig. 177.)

General Appearance.—The adults are clear-winged moths, the females having a wing expanse of about seven eighths of an inch, the males being somewhat smaller. The ground color of the body is black with oblique longitudinal stripes on the thorax and yellow bands around the abdomen. The antennæ are bluish black and the legs yellow with black rings. The fore wings are almost entirely covered with brown and black scales having a purple iridescence. There are yellow stripes between the veins and the outer border is brown and yellow. The hind wings are nearly all transparent with brown border. The tuft at the tip of the abdomen is yellow and black. The males are much darker than the females, having fewer and narrower yellow bands on the body and the anal tuft is larger and all black. The larvæ are

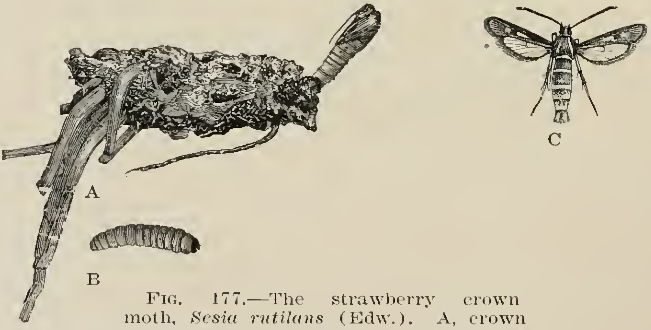

FIG. 177.—The strawberry crown moth, *Sesia rutilans* (Edw.). A, crown of strawberry plant showing chrysalis from which the adult has escaped; B, larva; C, adult. (After Klee.)

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*The name Ægeridæ is still applied to this family by many entomologists.

cylindrical; white with reddish-brown head, black legs and mandibles; covered with brownish hair and slightly over one half inch long. The pupæ are formed in brownish cocoons, the chrysalids being reddish brown with several rows of dark spines across the back and sides. They are about one half inch long and are usually found within the old burrows.

Life History.—The adult moths begin to issue about April, continuing until the latter part of July. The eggs are laid soon after the adults appear and the young larvæ apparently hatch and work during the winter and spring, most of the damage being done in the spring, about February, soon after which pupation begins so that adults may begin to issue in April. The broods overlap considerably as pupæ may be found as late as June.

Distribution.—Throughout the central and southern parts of the State, though specimens may occur quite far north in the Sacramento Valley.

Food Plants.—The larvæ work within the stems near the base or in the roots near the crown of the host plants. They are exceedingly destructive to strawberry plants, working within the crowns and roots. They also feed within the roots and canes of raspberry and blackberry plants. Their presence usually means the complete destruction of the plants unless control measures are promptly adopted.

Control.—Submersion, when possible, is a quick and thorough means of exterminating the pest but of course this is limited to irrigated districts. The fields should be flooded soon after the crop is harvested and the water left standing over the vines for four or five days. The destruction of weakened and infested plants is also recommended to prevent the spread of the moth. Valuable plants can be protected with screens or netting to prevent the moths depositing their eggs upon them.

THE IMPORTED CURRANT BORER.

Sesia tipuliformis (Clerck) (Family Sesiidæ).

(*Ægeria tipuliformis* Clerck.)

(Figs. 178, 179.)

General Appearance.—The adult females are clear-winged moths with delicate, slender bodies about three eighths of an inch long and a wing expanse of from five eighths to three fourths of an inch. The general color is jet black with deep blue iridescence. There is a yellow band around the base of the head; three distinct and two indistinct yellow bands around the abdomen and two oblique longitudinal yellow stripes on the thorax. Because of sunshine these lines and bands are misleading in the photograph (Fig. 178) excepting the last two abdominal rings in the left-hand specimen. The areas on the thorax just below the wings are also yellow. The fore wings are opaque along the borders, with a small band enclosing a clear area near the opaque tips which are bronze. The hind wings are clear, excepting a brown border. The legs are banded yellow and black with the inner sides of tibiæ and tarsi yellow and the outer sides black. The larvæ are slightly

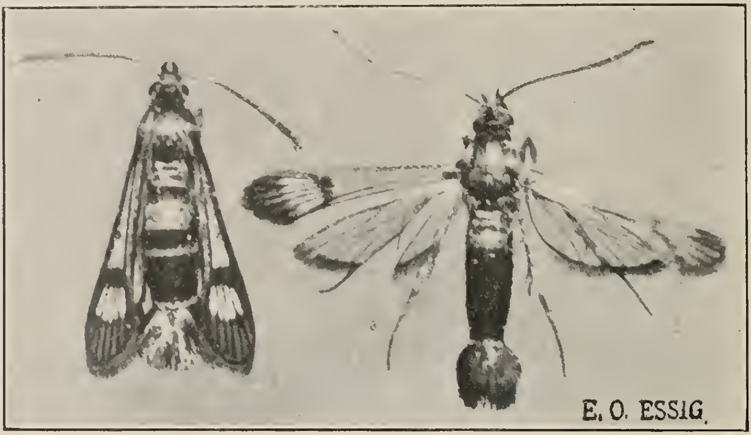

FIG. 178.—Adult females of the imported currant borer, *Sesia tipuliformis* (Clerck). The light-bands on the bodies are somewhat confusing, due to extremely bright light when the photograph was taken. (Original.)

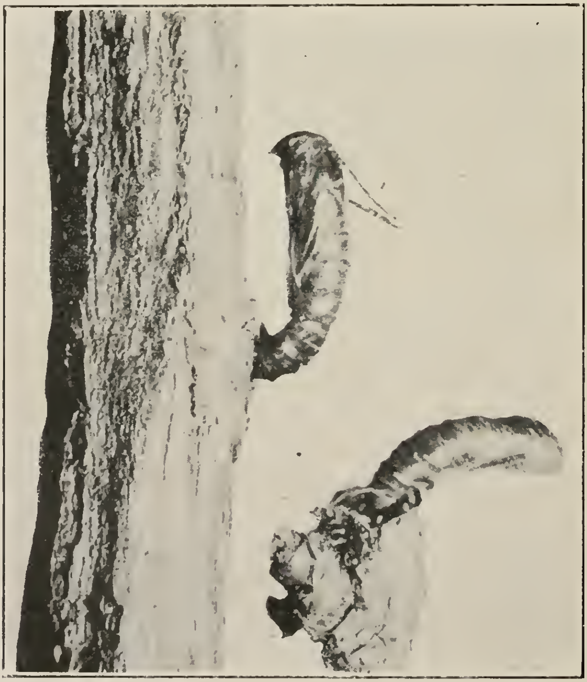

FIG. 179.—The pupæ cases of the imported currant borer, *Sesia tipuliformis* (Clerck), from which the adult moths have emerged. (Original.)

more than half an inch in length and yellowish white, with dark heads. The chrysalids are amber brown.

Life History.—The eggs are deposited in the early summer and the young upon hatching bore into the canes of the currants and work upon the inner pith during the summer and winter, eventually destroying the bushes. Late in the spring the pupæ are found within the old burrows near an opening through which the adult emerges, drawing nearly all of the pupal case after it. The winter is passed in the larval stage.

Distribution.—The imported currant borer is limited to the northern and central parts of the State and more particularly to the Sierra foothill regions.

Food Plants.—The young caterpillars work on the pith within the stalks or canes of the currant and gooseberry, doing much damage to the fruit-bearing wood. In not a few cases entire patches have been rendered worthless before the unsuspecting grower was aware of the real cause of the dying bushes.

Control.—Control is rather difficult and consists in cutting out and burning the sickly-looking canes as often as they appear.

THE CALIFORNIA PEACH BORER.

Sanninoidea opalescens Edw. (Family Sesiidæ).

(Figs. 180-182.)

General Appearance.—The adult moths are nearly one inch in length with somewhat greater wing expanse. They greatly resemble wasps in coloration and shape; the clear areas in the wings adding to the deception. The color is steel blue, the fringes of the wings and appendages are jet black—the legs having white tufts. The females have a bronzy hue with the fore wings entirely covered with dark scales. The dark-brown eggs are depressed on the sides and one end. The full grown larvæ are white or dusky in color with brown heads and attain a length of from one to one and one half inches. The pupæ are light brown and are found in the bark or around the bases of the trees.

Life History.—The eggs are always laid on the lower trunks of the trees a few inches above the surface of the soil. They are arranged singly or in small groups of from three to fifteen. Each moth lays from two hundred to over four hundred eggs and it requires from fifteen to thirty days for them to hatch. The newly hatched larvæ immediately seek shelter in cracks or crevices of the bark or beneath the ground and at once begin to enter the trunk of the tree by boring with great rapidity through the bark, or in infested orchards they enter the old burrows. During the summer the young work upon the growing inner bark, moving downward or upward at will. The burrows are usually made under the surface of the ground but occasionally they are extended quite far up the trunks. This is especially true on the silver prune. The frass and exuding gum are forced out of exit holes through the sides of the trees, thus greatly facilitating the location of the burrows. The larvæ remain in the burrows during the winter months and continue fairly active. About January and February they begin to transform into pupæ. These remain in the old burrows for about one and one half months, when the adults emerge in the spring and mate to begin egg laying. There is but one generation of overlapping broods each year.

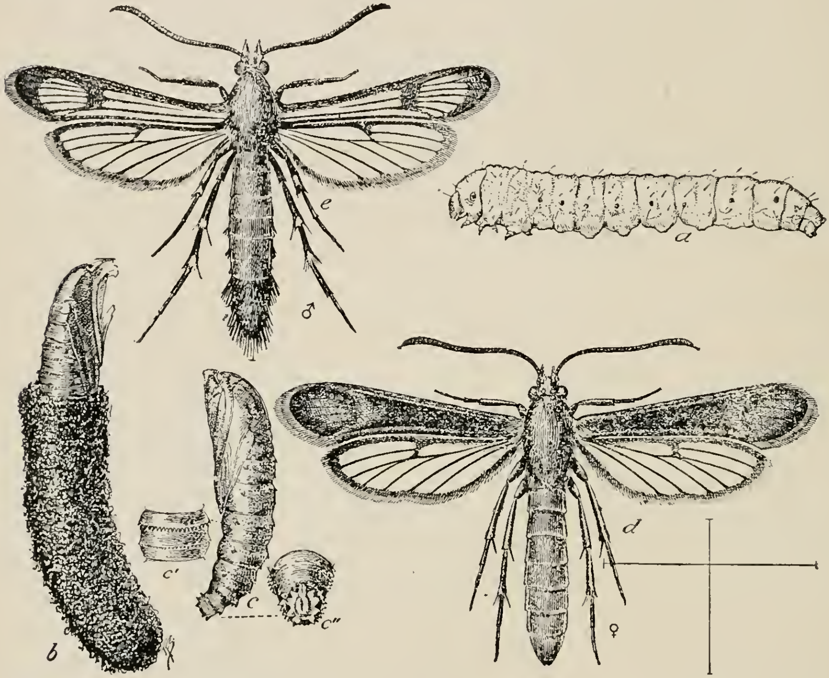

FIG. 180.—The California peach borer (*Sanninoidea opalescens* Edw.). *a*, larva; *b*, cocoon and pupal skin; *c*, pupa; *c'*, abdominal segments of same; *c''*, caudal end of same; *d*, adult female; *e*, adult male. Much enlarged. (U. S. Dept. Agrcl.)

Distribution.—At the present time the peach borer as a pest is confined to the Santa Clara Valley, and to Alameda and San Mateo counties.

Food Plants.—This insect is limited, as a pest, to a very small area of the State and is much dreaded because of the character of its work and the great damage it does to the trees it infests. Though principally a peach tree borer it works almost equally as destructively upon apricots, prunes, cherries, plums, western chokecherry (*Cerasus demissa*). Apple stock is attacked to some degree also.

Control.—Trees budded or grafted upon stocks of any of the host plants are sure to become infested, while it has been found that the borer will not injure trees grafted upon the Myrobalan plum (*Prunus cerasifera*). The use of this stock is becoming a sure means of controlling the pest in the future.

Protective washes of lime-crude oil mixture, lime-sulphur-salt mixture; or lime, coal tar, and whale-oil soap are recommended by Dudley Moulton as sprays to be applied before the middle of June. Digging out the worms or killing them with a crooked wire should be practiced in the winter months.

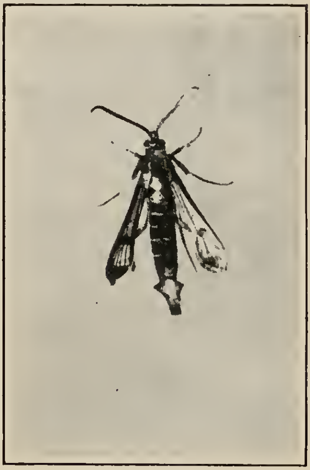

FIG. 181.—Adult male of the California peach borer. (Original.)

Earl Morris, horticultural commissioner of Santa Clara County, has invented a method of control that promises to be better than anything else yet tried. His method consists in applying grades "C" and "D" of hard asphaltum. This is done early in the spring to infested trees and a heavy coating prevents both the issuance and entrance of from ninety-five to ninety-eight per cent of the insects. The material when warm is applied from five to six inches below and above the soil surface with a brush. Two coatings are recommended. This method should follow fall and spring digging for the borers.

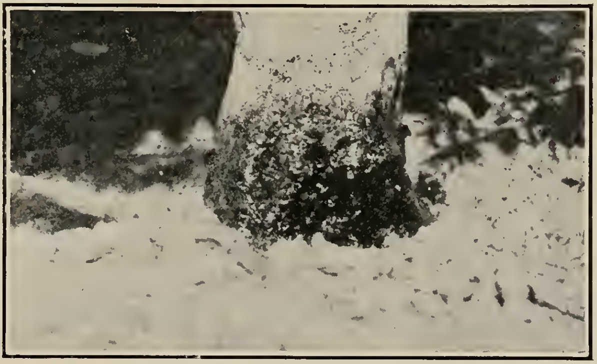

FIG. 182.—Peach tree showing the asphaltum treatment at the base for the peach borer (*Sanninoidea opalescens* Edw.). (After Morris, Courtesy Cal. Exp. Sta.)

THE IMPORTED CABBAGE WORM.

Pontia rapæ Sch. (Family Pieridæ).
(*Pieris rapæ* Linn.)
(Fig. 183.)

General Appearance.—Though this is an imported insect it has become as common as if it had always been here. The adult butterflies are about one and one fourth inches long with a wing expanse of two inches. The color is white with two small black spots near the middle and a large black spot at the tip of each fore wing. The caterpillars are light velvety green in color and very finely dotted with minute dark spots. The length when full grown varies from one to one and one half inches. The chrysalis is about one inch long and varies in color from yellow to green, light or dark gray.

Life History.—In the northern part of the State the species winters over in the chrysalis stage, while in the south adult butterflies may be seen almost any time of the year. They become very much in evidence early in March and are active throughout the entire summer and fall. Egg laying begins soon after the adults leave the chrysalis stage. The eggs hatch in about a week and the young caterpillars begin feeding at once. They first feed upon the outer leaves, making them ragged and holey, but gradually work through towards the heart of the cabbage, leaving the dark-green excrement to mark their paths of destruction. The growth is very rapid so that in from one to two weeks they are ready to select some secluded spot beneath an old cabbage leaf or some nearby object and prepare for the chrysalis stage, which, during the first two generations in the summer months, lasts little longer than the larval stage, but which in the fall continues throughout the winter. There are several generations a year. In fact in the southern part of the State it seems as if the breeding is only slightly checked during the winter months.

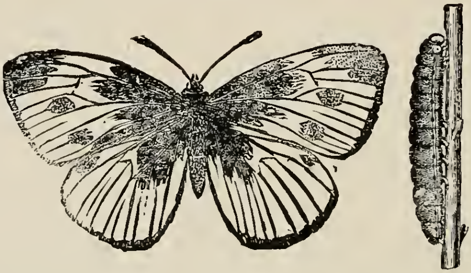

FIG. 183.—Adult and larva of the imported cabbage worm (*Pontia rapæ* Sch.). (U. S. Dept. Agrcl.)

Distribution.—Very common in every part of the State.

Food Plants.—The principal economic food plants are cabbage, cauliflower, brussels sprouts, turnip, radish, mustard, and horseradish.

Other plants attacked are wild mustard, wild radish, nasturtium, mignonette and sweet alyssum.

Control.—The larvæ, working as they do into the heads of the cabbages, make control methods practically impossible after they have once begun. Young plants may well be protected by arsenical sprays which are applied with safety until the heads are half-grown. Prof. L. Bruner claims that cornmeal dusted on the cabbages causes the worms to leave. Clean culture should be practiced and no cabbage or host plants allowed to grow during the interval between crops unless they are freely sprayed with strong solutions of arsenical sprays.

Natural Enemies.—Internal parasites, working upon the chrysalids, are important factors in the control of the pest. In this State the small parasite (*Pteromalus puparum*) is quite widely distributed and is bred and sent to all parts of the State by the State Insectary. In the Eastern States a chalcid (*Apanteles glomeratus*) does excellent work in killing off the caterpillars, but this has not been established in this State. A bug (*Phymata wolffii*) preys upon the butterflies, which they capture on flowers while the wasp (*Polistes pallipes*) destroys large numbers of the worms.

THE CELERY OR PARSLEY CATERPILLAR.

Papilio polyxenes Fab. (Family Papilionidæ).

(*Papilio asterias* Fab.)

(Fig. 184.)

General Appearance.—The most evident forms of this insect are the feeding caterpillars, which are indeed very striking. The youngest of these are noticeably darker with yellow spots. When full grown they are yellowish green with distinct black bands and dots on the bodies. If disturbed they throw out a forked, orange-colored scent organ behind

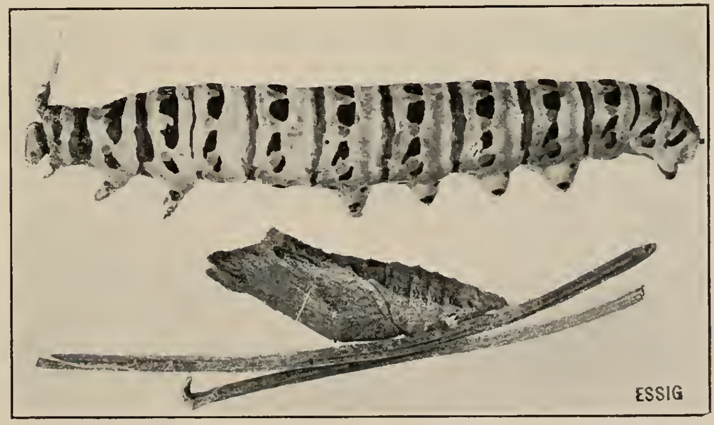

Fig. 184.—Caterpillar and chrysalis of the parsley butterfly (*Papilio polyxenes* Fab.). (Original.)

the head, which exhales a very pungent and characteristic odor. The eggs are about 1 mm. in length, at first yellow and later reddish brown in color, and flattened at the attached end. The adult butterflies are commonly known as the black swallowtails, being black with yellow markings. The chrysalids vary from green to dull gray and are more or less mottled.

Life History.—The eggs are laid upon the food plants from spring to early summer and hatch in about ten days. The caterpillars are voracious feeders and develop very rapidly, being ready to form chrysalids in about one month after hatching. Chrysalids hatch in about two weeks. The adults being strong fliers are able to scatter their broods over large areas. There are several generations a year.

Distribution.—The caterpillars are to be found in nearly every garden in the State. This is especially true of the central part.

Food Plants.—In many localities this caterpillar is a serious pest of celery and parsley, but feeds also upon carrots, caraway, parsnips, dill, fennel and related wild plants.

Control.—Though the caterpillars may be controlled by poison sprays on some crops, these are not safe for celery and parsley. The larvæ are so conspicuous as to make hand picking one of the best methods of control. If care is exercised to collect and destroy the first larvæ the second and more damaging brood will be greatly reduced. Concerted action on the part of all growers is necessary to bring satisfactory results.

Natural Enemies.—The ichneumon parasites, *Trogus vulpinus* Grav. and *T. exidianator* Brullé, destroy great numbers of the chrysalids.

THE CALIFORNIA ORANGE DOG.

Papilio zolicaon Boisd. (Family Papilionidæ.)

General Appearance.—The adult butterfly is one of the smaller swallow-tails having a wing expanse of from two to three and one half inches. The color is black and orange-yellow, each being about equal in extent—the yellow being distributed along the edges and in the middle of the wings.

Life History.—The eggs are laid singly upon the lower surfaces of the leaves, there being from five to seven on a tree. Upon hatching the larvæ at once begin to feed upon the foliage. Development is rapid. The chrysalids are found in sheltered places and form the over-wintering stage. The adults appear early in the spring.

Distribution.—One of the most widely distributed species, being especially abundant in Tulare County, in the San Joaquin Valley and other parts of the State.

Food Plants.—The natural food plants of this insect are various species of *Umbelliferæ*, the most favored ones being *Fœniculum vulgare* and *Carum kelloggii.* In the Porterville section, as well as in the vicinity of Riverside, the larvæ feed upon orange trees and in the former district promise to be a pest.

Control.—The larvæ occur singly and in rather few numbers upon the trees, but their ravenous appetites and ability to consume great amounts of foliage often makes control necessary. As they are easily located hand picking is the remedy recommended.

Natural Enemies.—Fortunately natural enemies play a large part in the control of this insect, otherwise greater damage would be done. Mr. Karl R. Coolidge, who first called attention to it as an orange pest, states that a tachinid fly and a species of *Apanteles* prey upon the larvæ.

COLEOPTERA (Order).

SHEATH-WINGED INSECTS.

BEETLES AND WEEVILS.

The insects of this order are easily recognized by their hard, leathery elytra, commonly known as wing covers. The true wings are folded underneath these. All forms have complete metamorphoses, the young being wormlike and known as grubs. They usually have but six functional legs. The pupal stage is quiescent. The mouth-parts are for biting and chewing.

All of the members of this order are extremely destructive, the grubs and adults working throughout their entire existence. There are great numbers of destructive beetles and weevils in California but we can include only a few of the more important ones.

COCCINELLIDÆ (Family).

LADYBIRD BEETLES.

This family of beetles is one of the most important and beneficial among insects. Only one genus of a few species is destructive, while the rest are particularly noted for their work upon scale insects (*Coccidæ*) and plant lice (*Aphididæ*).

Eggs.—The eggs vary considerably with the different members of the family and are seldom if ever observed. Those most often met with are the salmon-colored masses (Fig. 189B) of the *Hippodamia* sps., which are laid on ends not unlike bunches of cigars. Others are deposited singly upon or underneath individual scale insects, in the egg-masses of mealy bugs or among plant lice.

Larvæ.—The young grubs or larvæ are exceedingly active and begin to feed soon after hatching. As the period of growth is short their ability to consume food must be great, and we find them unexcelled as predators. They have rather long, pointed and flattened bodies (Fig. 189 C), well developed mouth-parts and six legs. The colors are exceedingly variable, the bodies are hairy, some being covered with long, white threads of wax (Fig. 208). Besides the coverings they are protected by offensive secretions and are not generally preyed upon by insectivorous animals. During their growth they moult four times and when fully matured seek shelter to pupate.

Pupæ or Nymphs.—The larvæ not having a waxy or exceedingly hairy or spiny covering, usually hang by the tail and pupate with the head downward (Fig. 189D), while the covered ones pupate within the larval skins which give ample protection. Offensive liquids are also secreted for protective purposes. The naked nymphs have the ability to move the suspended body very rapidly when disturbed.

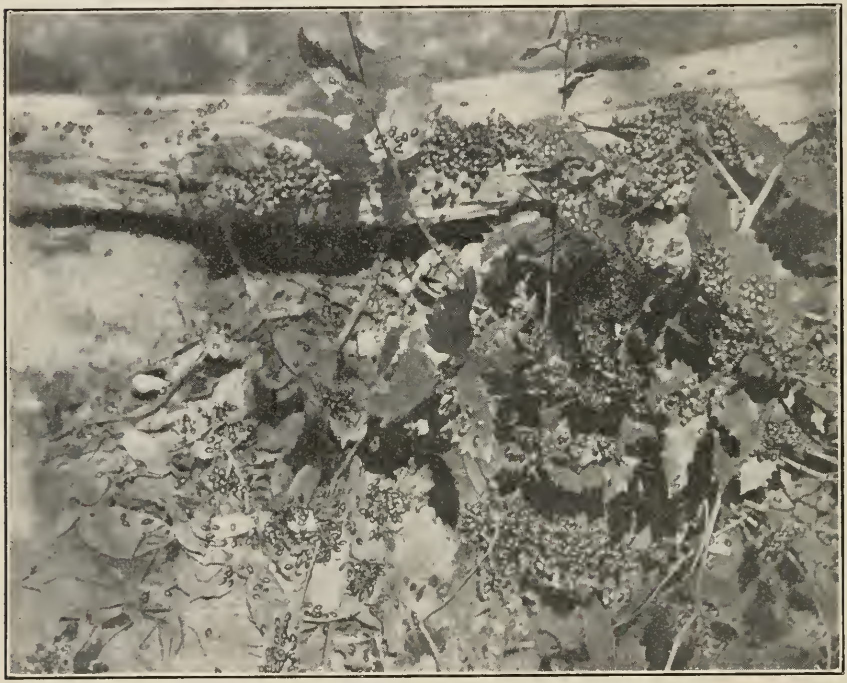

FIG. 185.—Two species of *Coccinellidæ* (*Hippodamia convergens* Guér. and *H. ambigua* Lec.) emerging from hibernating quarters in the spring. (After Carnes.)

Adults.—The adult beetles emerge through slits in the pupal skins. They are exceedingly active, feeding throughout their existence. In size they vary from one sixteenth to nearly one half inch in length. The color is usually showy and of many shades and combinations. The males are somewhat smaller than the females and sometimes with slightly different colorations. The winter is passed in hibernation. In some species thousands of individuals collect in the mountains in great colonies. With the first warm spring weather these emerge from the winter quarters and migrate to the lower valleys and disperse to give rise to succeeding generations.

*THE STRIPED LADYBIRD BEETLE.

Paranæmia vittigera (Mann.).

(*Megilla vittigera* Mann.)

(Fig. 186.)

General Appearance.—The adult beetles vary from a straw or light pink to almost bronze and have three broad, longitudinal, black stripes on the back, dark head, and two black blotches on the prothorax.

Distribution.—The adults hibernate in quite large colonies and are found in most parts of the State, and especially in the southern part. They seem to prefer damp places and are usually common in sugar beet fields. At Oxnard, California, the writer found this species in great numbers.

Hosts.—Feed upon root lice, such as the beet louse (*Pemphigus betæ*), and other soft-bodied insects.

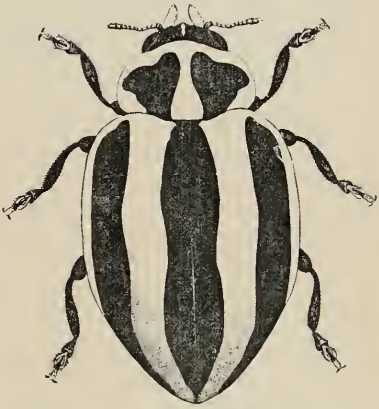

FIG. 186.—The striped ladybird beetle, *Paranæmia vittigera* (Mann.). (Original. Drawing by Birdnekoff.)

Hippodamia 5-signata Kirby.

(Fig. 187.)

General Appearance.—The adult beetles are slightly more than three sixteenths of an inch long and rather robust. The head is black with white front and margins; thorax black with white margins and sometimes two white spots near the middle; elytra, or wing covers, yellow or red with a broad black band extending nearly across the base, a wide black band behind the middle and a black spot near the tip of each. There is sometimes a very small black spot near the margin and base of each wing cover. The body proper and legs are black.

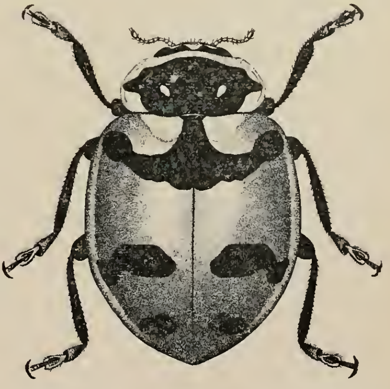

FIG. 187.—*Hippodamia 5-signata* Kirby. (Original. Drawing by Birdnekoff.)

Distribution.—Especially abundant in the northern part of the State, but is also found in all other sections, though only in limited numbers.

Hosts.—Prey particularly upon plant lice.

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*The writer is indebted to Mr. F. W. Nunenmacher for the correct naming of these species.

Hippodamia lecontii Muls.

(Fig. 188.)

General Appearance.—About the same size and shape as *Hippodamia convergens.* The head is black with a white spot in middle; thorax entirely black with lateral and front margins white; elytra red with one very faint small black and two well defined spots near the base of each—the two spots near the middle front of the elytra often unite with the scutellar spot at the extreme middle base to form an inverted "Y" (Fig. 188). Near the tip of each wing cover there are two spots, the hind one being small, while the other is large and often appears to be two spots united. In some individuals the markings may appear almost identical with those of *Hippodamia convergens*, but the slender white spots are always lacking on the middle of the prothorax.

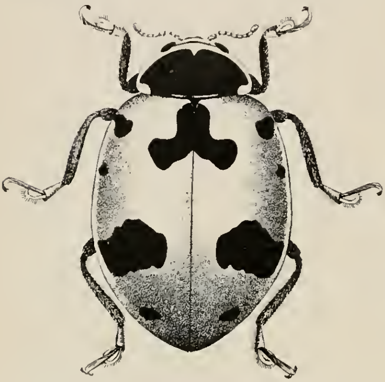

FIG. 188.—*Hippodamia lecontii* Muls. (Original. Drawing by Birdnekoff.)

Distribution.—Throughout the entire State, but not abundant.

Hosts.—Preys principally upon plant lice.

THE COMMON BLACK-SPOTTED RED LADYBIRD BEETLE.

Hippodamia convergens Guér.

(Fig. 189.)

General Appearance.—The commonest of all ladybird beetles in this State and easily distinguished by the red color and the twelve black spots on the elytra. The head and thorax are black, the latter with two narrow lateral white margins and a very small medium white spot at the base.

Life History.—The eggs are salmon-colored and deposited in clusters not unlike bunches of cigars on their ends. The dark larvæ soon after emerging search for food, which at first consists of very small insects, such as young scale insects. Full grown larvæ are nearly one half inch long and have several reddish or salmon-colored spots on the thoracic segments. The pupa varies from yellow to reddish with black markings. All stages of the species exist throughout the summer months and may be found almost anywhere.

Distribution.—Throughout the entire State. The species hibernates in great colonies in the high Sierras, from whence it descends into the lowlands as soon as warm weather melts the snow.

Hosts.—Soft bodied insects, such as plant lice, young scale insects, other species of ladybird beetles, and they may even be cannibalistic. The principal food consists of plant lice, chief of which are the melon aphis (*Aphis gossypii* Glover), the pea louse (*Macrosiphum destructor* Johns.), the bean aphis (*Aphis rumicis* Linn.) and the woolly aphis, *Eriosoma lanigera* (Hausm.)

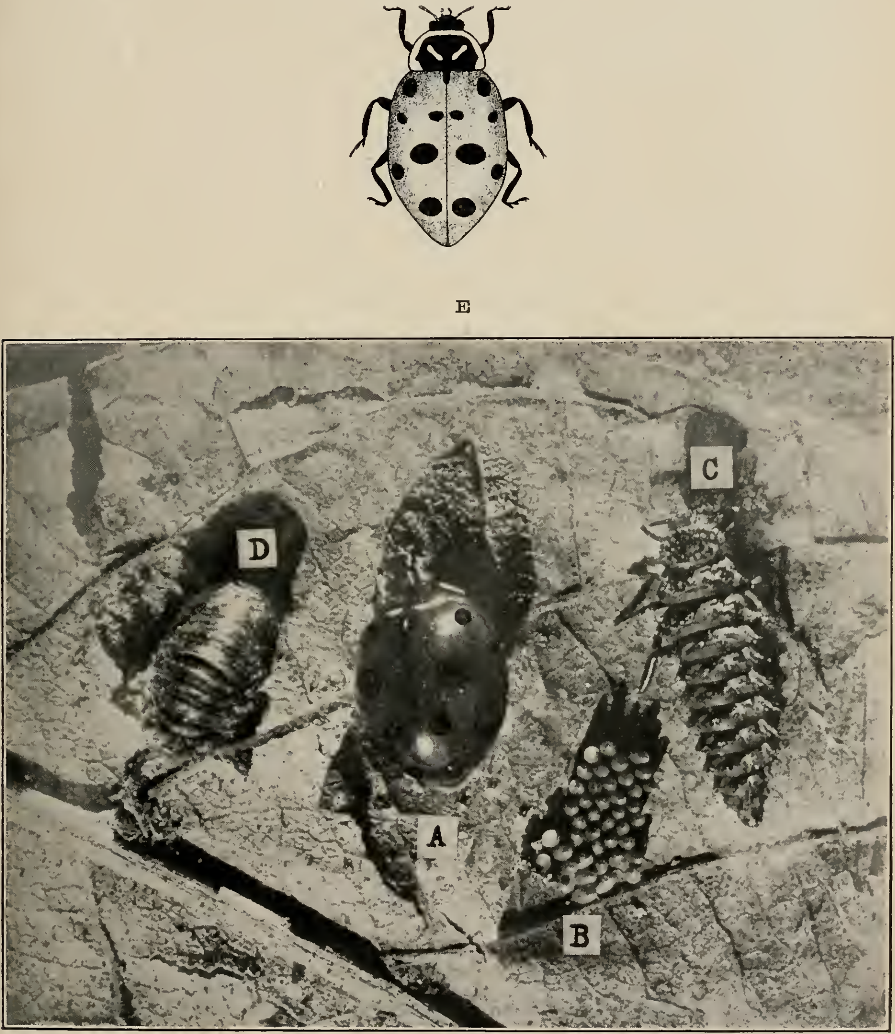

FIG. 189.—The common black-spotted red ladybird beetle (*Hippodamia convergens* Guér.). A and E, adults; B, eggs; C, larva; D, pupa. (Essig, P. C. Jr. Ent.)

THE COMMON RED LADYBIRD BEETLE.

**Hippodamia ambigua* Lec.

(Figs. 190, 191.)

General Appearance.—The adult beetles greatly resemble the black-spotted red ladybird beetle (*Hippodamia convergens*) in size and shape. The wing covers are entirely red with a single black spot at the middle of their bases and an indistinct light area on each side of this spot. The thorax is black with narrow lateral margin and two narrow median spots white. The head is black with median and marginal light spots. The eggs and immature forms are practically the same as those of *Hippodamia convergens*.

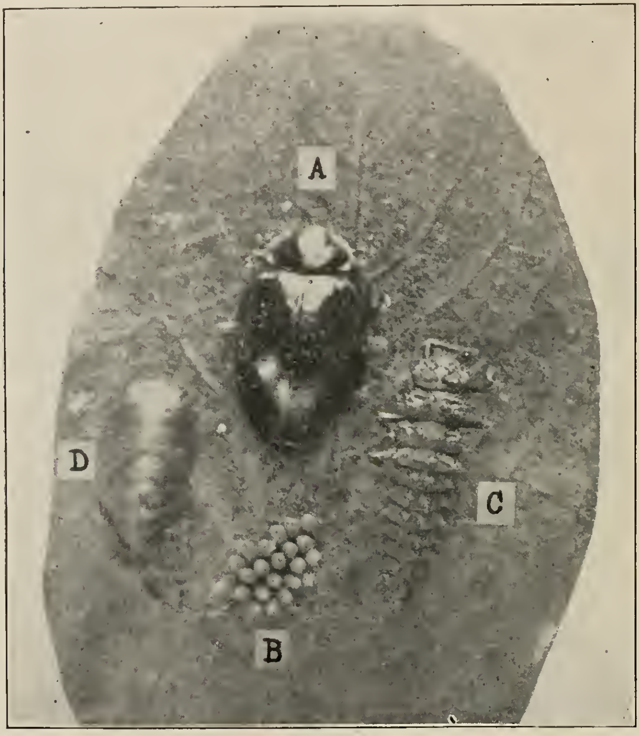

FIG. 190.—The common red ladybird beetle (*Hippodamia ambigua* Lec.). A, adult; B, eggs; C, larva; D, pupa. (Essig, P. C. Jr. Ent.)

Distribution.—Throughout the entire State. A very common species, hibernating with and accompanying *Hippodamia convergens*.

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*This is now being considered as a varietal form of *Hippodamia convergens* Guér.

Hosts.—Feeds upon practically the same hosts as does *Hippodamia convergens*, and has also been reported as preying upon young cottony cushion scale (*Icerya purchasi*).

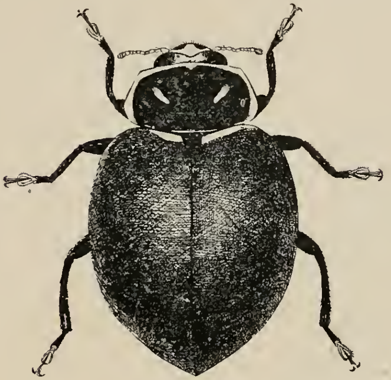

Fig. 191.—Adult of the common red ladybird beetle, *Hippodamia ambigua* Lec. (Original. Drawing by Birdnekoff.)

THE TWO-SPOTTED LADYBIRD BEETLE.

Adalia bipunctata Linn.

(Fig. 192.)

General Appearance.—The adult beetles are red with a black spot on each wing cover; thorax black with white margins and two small light spots near the middle base; head black with light antennæ and palpi; legs black with pale feet.

Distribution.—This beetle was sent to California by Mr. B. M. Lelong in the year 1889, and has become established more particularly in the central part of the State. The writer has specimens collected in Alameda County.

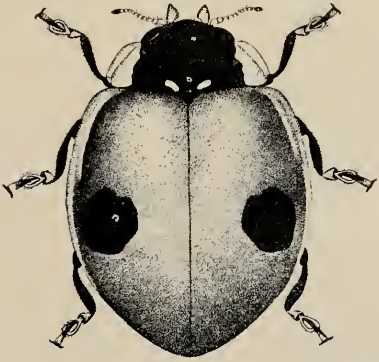

Fig. 192.—The two-spotted ladybird beetle, *Adalia bipunctata* Linn. (Original. Drawing by Birdnekoff.)

Hosts.—The larvæ and adults of this ladybird beetle feed almost entirely upon plant lice.

Adalia bipunctata var. *humeralis* Say.

(Fig. 193.)

General Appearance.—The adult beetles are oval-elongate in shape and three sixteenths of an inch long. The color is shiny black with the spots on the face and margins of the prothorax red. There are two large red spots at the marginal bases and two smaller circular red spots back of the middle of the wing covers.

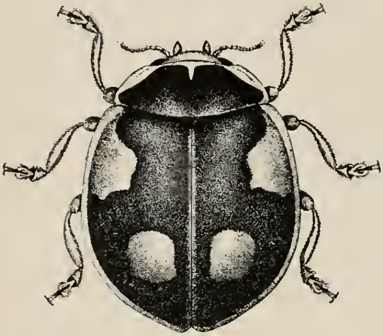

Fig. 193.—*Adalia bipunctata* var. *humeralis* Say. (Original. Drawing by Birdnekoff.)

Distribution.—Occurs in the central part of the State, though not at all numerous.

Hosts.—Works principally upon plant lice.

Coccinella trifasciata var. *juliana* Muls.

(Fig. 194.)

General Appearance.—The adult beetles are oval in shape; convex and three sixteenths of an inch long. The head is white except a narrow black line near the prothorax and the black eyes; prothorax black with all the front and lateral margins, except the extreme base, white; elytra, or wing covers, yellow or red with a single wide black band extending nearly across at the base. The body and legs are black.

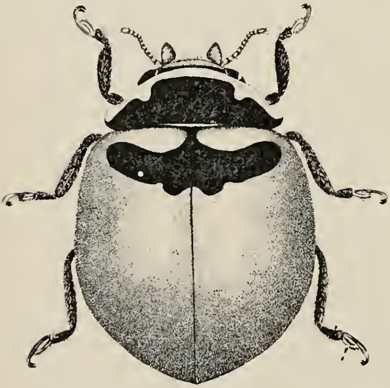

Fig. 194.—*Coccinella trifasciata* var. *juliana* Muls. (Original. Drawing by Birdnekoff.)

Distribution. — Occurs more abundantly in the northern and central parts of the State.

Hosts.—Works principally upon plant lice and other soft-bodied bugs.

THE CALIFORNIA RED LADYBIRD BEETLE.

Coccinella californica Mann.

(Fig. 195.)

General Appearance.—Average sized ladybird beetle, rather short, being about three fourths as wide as long. The head is black; thorax black with a white or pale spot on each margin; elytra, orange or scarlet-red with no other marking than a small rhomoidal dark spot at their middle base, known as the scutellar spot.

Distribution.—A very common species to be found throughout the State and especially abundant in the northern coast counties.

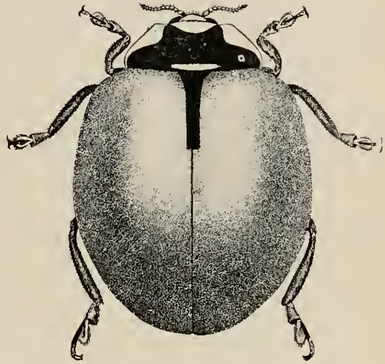

Fig. 195.—The California red ladybird beetle, *Coccinella californica* Mann. (Original. Drawing by Birdnekoff.)

Hosts. — Feeds largely upon aphids. In the northern and central parts of the State the cabbage aphis (*Aphis brassicæ* Linn.) is a favorite host. It also feeds upon young scale insects.

THE BLOOD-RED LADYBIRD BEETLE.

Cycloneda sanguinea (Linn.).

(Fig. 196.)

General Appearance.—The adults are about three sixteenths of an inch long and rounded oval, somewhat convex in shape. The elytra are dark red or yellowish in color with margins and bases paler. The head is black with front of male white and two white spots on the female; thorax is black with front white and in the shape of a broad "W," but sometimes having two lateral black spots in the white area. The body proper is entirely black, the feet being a little paler.

Distribution.—Common throughout the entire State.

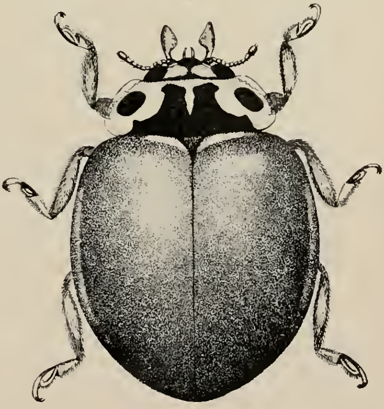

Fig. 196.—The blood-red ladybird beetle, *Cycloneda sanguinea* (Linn.). (Original. Drawing by Birdnekoff.)

Hosts.—Preys upon plant lice and young scale insects.

THE ASHY-GRAY LADYBIRD BEETLE.

Olla abdominalis Say.

(*Cycloneda abdominalis* Say.)

(Figs. 197, 198.)

General Appearance.—Yellowish-gray ground color with many small dark spots on the dorsum. The body is average size, being about one fourth inch long and is distinctly broad or almost globular in shape.

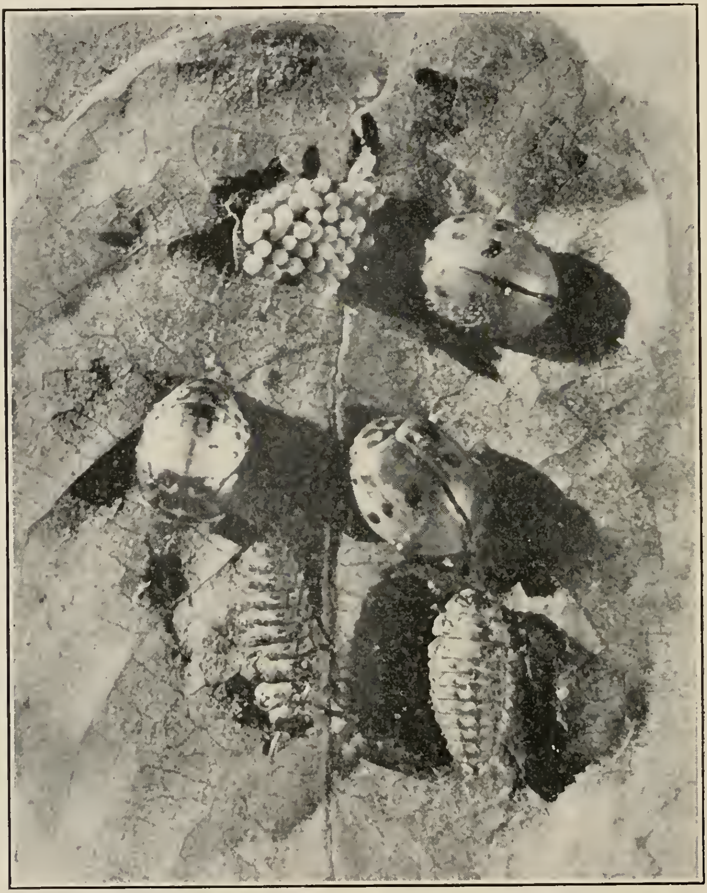

FIG. 197.—Ashy-gray ladybird beetle (*Olla abdominalis* Say), showing eggs at top, adults at right-hand middle, pupa at left-hand middle, larvæ at the bottom. (Essig, P. C. Jr. Ent.)

Life History.—Greatly resembles that of *Hippodamia convergens*. The larvæ have yellow spots on the dorsum instead of red and the pupa is much lighter in color. It is not known to hibernate in such numbers as the red forms and is not nearly as common. Works throughout the summer months.

Distribution.—Throughout the State, but abundant only in the southern part, especially in the walnut orchards of Ventura County.

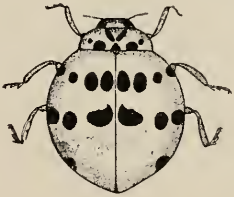

Fig. 198.—Adult ashy gray ladybird beetle, *Olla abdominalis* Say. (Essig, P. C. Jr. Ent.)

Hosts.—On many species of plant lice, but is the most effectual check on the walnut plant louse, which it often entirely subdues before winter.

THE EYED LADYBIRD BEETLE.

Olla oculata Fab.

(*Cycloneda oculata* Fab.)

(Fig. 199.)

General Appearance.—The adults of this species are often mistaken for the two-stabbed ladybird (*Chilocorus bivulnerus*). They are somewhat larger with the spots on the wing covers reddish-yellow and larger. The head and lower edges of the thorax are also reddish-yellow.

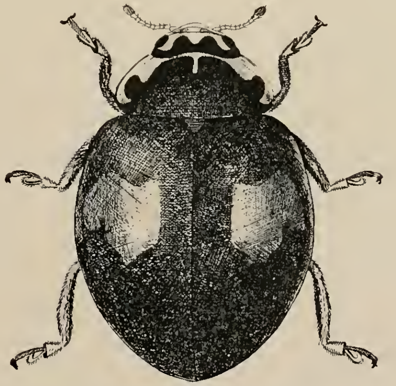

Fig. 199.—The eyed ladybird beetle, *Olla oculata* Fab. (Original. Drawing by Birdnekoff.)

Distribution.—Quite common throughout the State and most abundant in the central and southern parts.

Hosts.—This species feeds upon scale insects.

Olla plagiata Casey.

(Fig. 200.)

General Appearance.—The adult beetles are broadly rounded; about three sixteenths of an inch long and three fourths as wide. The head is pale; pronotum black with pale lateral margins; wing covers black with a large, irregular, red blotch slightly in front of the middle of each. The under surface of the head and thorax and bases of the legs are black; tips of legs and abdomen pale.

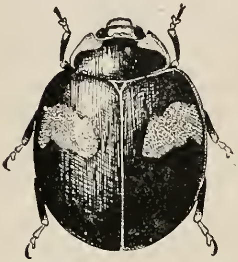

Fig. 200.—*Olla plagiata* Casey. (After Quayle. Courtesy Cal. Exp. Sta.)

Distribution.—Throughout the central and southern parts of the State, but not abundant.

Hosts.—This species preys principally upon plant lice.

THE SMALL GRAY LADYBIRD BEETLE.

Psyllobora tædata Lec.

(Fig. 201.)

General Appearance.—A very small gray beetle with many fine dark brown irregular spots or blotches on the elytra. Scarcely one eighth of an inch long and oblong in shape. The larvæ are also small and vary from straw to gray in color.

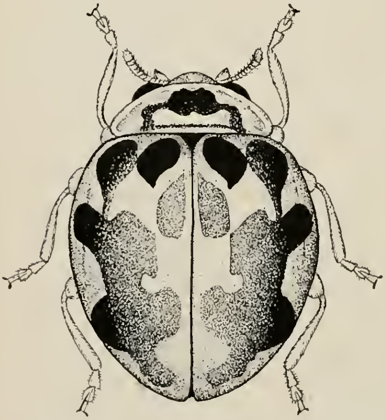

Fig. 201.—The small gray ladybird beetle, *Psyllobora tædata* Lec. (Original. Drawing by Birdnekoff.)

Life History.—This species is so small that only the first hatched scale insects are devoured, but the great numbers of the beetles enables them to do much good. The young and adults alike are very active and feed almost constantly.

Distribution.—A native species especially abundant in the southern part of the State in the coast counties from Santa Barbara to San Diego.

Hosts.—Young black scale, aphids and mites.

THE TWO-STABBED LADYBIRD BEETLE.

Chilocorus bivulnerus Muls.

(Fig. 202.)

General Appearance.—The adults are broadly oval and about three sixteenths of an inch long. The color is shiny black with two round blood-red spots upon the elytra. The extreme margins of the prothorax are pale. The under side of the abdomen is red. The larvæ are very shiny, dark in color, with a yellow transverse band across the middle.

Distribution.—This is one of the native ladybird beetles and is to be found in almost every part of the State.

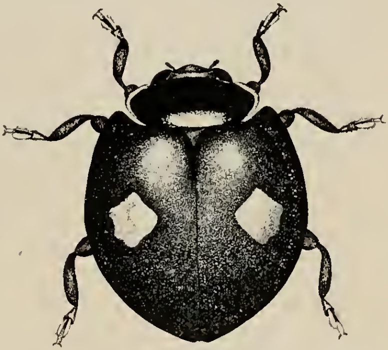

FIG. 202.—The two-stabbed ladybird beetle, *Chilocorus bivulnerus* Muls. (Original. Drawing by Birdnekoff.)

Hosts.—The larvæ and adults are voracious feeders upon the San José scale (*Aspidiotus perniciosus*), young of the black scale (*Saissetia oleæ*), mealy bugs (*Pseudococcus citri* and *P. longispinus*), oyster shell scale (*Lepidosaphes ulmi*), European elm scale (*Gossyparia spuria*) and other scale insects.

THE STEEL-BLUE LADYBIRD BEETLE.

Orcus chalybeus (Boisd.).

(Fig. 203.)

General Appearance.—The adults of this beetle are metallic steel-blue or green in color, almost hemispherical in shape and between one eighth and three eighths of an inch in diameter. The head of the male is yellow.

Distribution.—Originally distributed throughout the entire southern part of the State, but is now almost entirely confined to the districts around Carpinteria in Santa Barbara County, where it is well established. Introduced into California by Albert Kœbele.

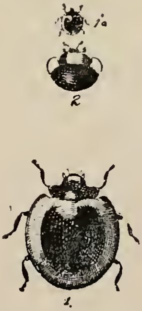

FIG. 203.—The steel-blue ladybird beetle, *Orcus chalybeus* (Boisd.). Top natural size. (Agrcl. Gaz. N. S. W.)

Hosts.—Feeds upon many armored coccids, including red scale (*Chrysomphalus aurantii*), yellow scale (*Chrysomphalus citrinus*), *Chrysomphalus rossi*, purple scale (*Lepidosaphes beckii*), San José scale (*Aspidiotus perniciosus*) and black scale (*Saissetia oleæ*).

Axion plagiatus Oliv.

(Fig. 204.)

General Appearance.—The adult beetles are quite large, attaining one fourth of an inch in length and nearly that much in width. The shape is broadly oval and convex, being almost hemispherical; color, shining black throughout with two large red blotches nearly covering the basal halves of the wing covers. These spots are smaller on the males. The apical margins of the pronotum are pale.

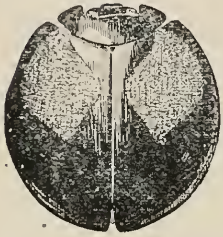

Fig. 204.—*Axion plagiatus* Oliv. (After Quayle. Courtesy Cal. Exp. Sta.)

Distribution.—Apparently limited to the southern part of the State.

Hosts.—Feeds upon young black scale and other young scale insects.

PILATE'S LADYBIRD BEETLE.

Axion pilatii Muls.

(*Exochomus pilatii* Muls.)

(Fig. 205.)

General Appearance.—The adult beetles resemble the two-stabbed and also the eyed ladybird, but are larger than the former and have smaller and darker red spots than the latter. They also differ from the two-stabbed ladybird beetle by having the under extremity of the abdomen black instead of red. The larvæ are larger and lighter than the young of the two-stabbed beetle but otherwise greatly resemble them.

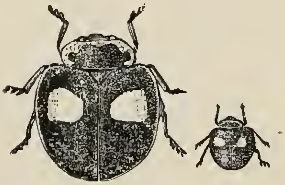

Fig. 205.—Pilate's ladybird beetle, *Axion pilatii* Muls. Enlarged and natural size. (Cal. Hort. Com.)

Distribution.—Occurs in limited numbers in the southern part of the State.

Hosts.—Feeds upon scale insects—young black scale seeming to be preferred.

Exochomus californicus Casey.

(Fig. 206.)

General Appearance.—The adult beetles are broadly oval, convex in shape and about three sixteenths of an inch long. The color is shiny black with a long reddish spot at the marginal base and a rounded spot of the same color near the tip of each wing cover.

Distribution.—Occurs throughout the entire State from Siskiyou to San Diego counties.

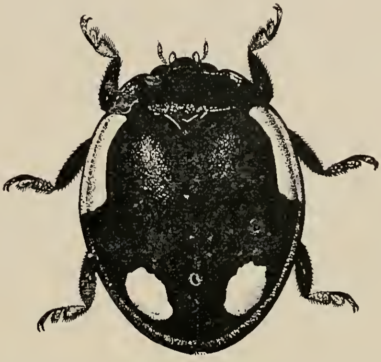

Fig. 206.—*Exochomus californicus* Casey. (Original. Drawing by Birdnekoff.)

Hosts.—The young and adults feed upon plant lice, scales and other small soft-bodied insects.

Cryptogonus orbiculus Schön.

(Fig. 207.)

General Appearance.—The adults appear at first sight to be black but upon closer examination it will be found that there are two quite large reddish-brown spots upon the back as shown in Fig. 207. They are elongate or oval in shape, scarcely one eighth of an inch long and are exceedingly active. The eggs are very small, oblong, yellow and laid singly. The larvæ have yellow bodies which are entirely covered with long white cottony-like filaments. The pupal stage is passed within the old larval skin.

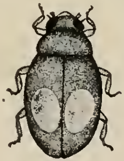

Fig. 207.—*Cryptogonus orbiculus* Schön (Essig, P. C. Jr. Ent.)

Distribution.—The ladybird beetle was introduced into California by Geo. Compere from the Philippine Islands during the year 1910 and liberated in the central and southern parts of the State, where it has become established.

Hosts.—The larvæ and adults work primarily upon the eggs and young of the citrus mealy bug (*Pseudococcus citri*) and the long-tailed mealy bug (*Pseudococcus longispinus*).

THE MEALY BUG DESTROYER.

Cryptolæmus montrouzieri Muls.

(Figs. 208, 209.)

General Appearance.—Adults are as large as the ordinary red ladybird beetle, but decidedly pointed posteriorly. They are black with head, prothorax and posterior fourth of the elytra cinnamon red. The larvæ are yellow and covered with long filaments of white flocculence (Fig. 208A).

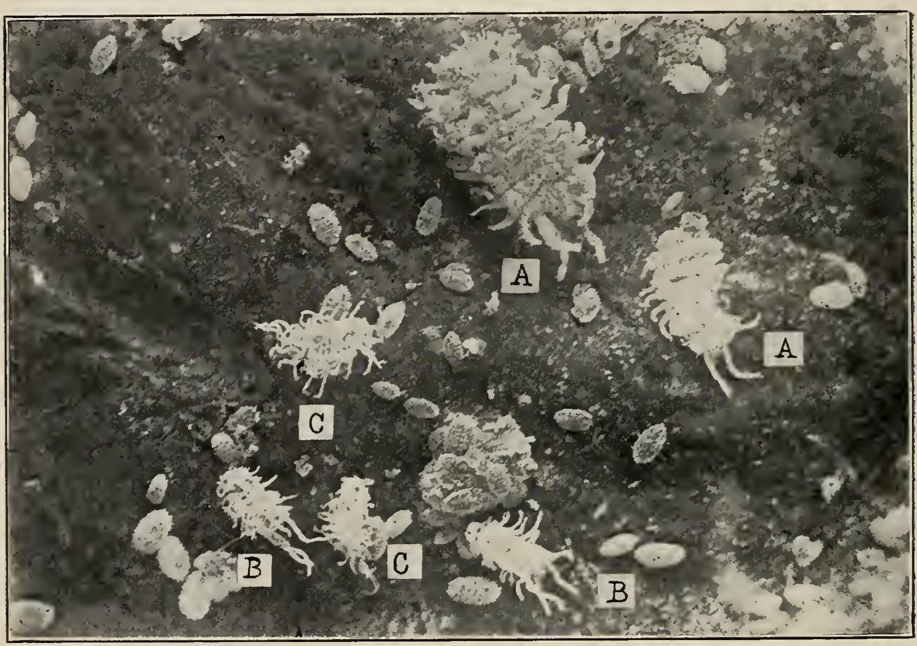

FIG. 208.—Larvæ of ladybird beetles. A, *Cryptolæmus montrouzieri* Muls. B, *Cryptogonus orbiculus* Schön.; C, *Scymnus guttulatus* Lec. (Essig, P. C. Jr. Ent.)

Life History.—The eggs are lemon yellow and deposited early in the summer among the egg masses of the mealy bugs. The young prey upon the eggs, young and adults of the host and work great havoc. They are most plentiful during the months of August and September. The pupal stage is passed within the old larval skin. The adults hibernate over winter.

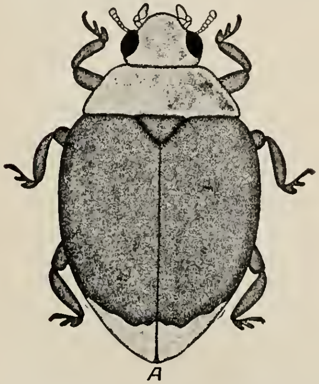

FIG. 209.—Adult female of *Cryptolæmus montrouzieri* Muls. (Essig, P. C. Jr. Ent.)

Distribution.—Throughout the mealy bug infested districts of the State. This species was introduced into California by Albert Kœbele and is redistributed from time to time by the State Insectary.

Hosts.—This is by far the most important natural enemy preying upon the various species of mealy bugs including *Pseudococcus citri, P. longispinus P. nipæ* as well as other species. In not a few cases it has done excellent work in destroying the citrus mealy bug.

Hyperaspis lateralis Muls.

(Fig. 210.)

General Appearance.—A rather small, black ladybird beetle, nearly hemispherical in shape and slightly more than one eighth of an inch in diameter. There are two red or yellow spots on the wing covers near the apex, two on the disc and two long narrow blotches on the front lateral margins. The edges of the thorax and front of head are yellow. The larvæ are yellow and entirely covered with long, white, cottony-like filaments. The pupæ of this ladybird are destroyed in great numbers by an internal hymenopterous parasite which keeps the species from doing effective work on the mealy bugs.

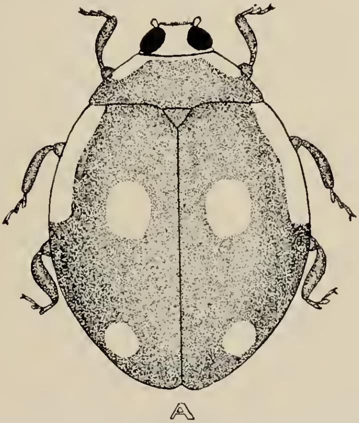

FIG. 210.—*Hyperaspis lateralis* Muls.

(Essig, P. C. Jr. Ent.)

Distribution.—One of the commonest of the coccid feeders, being more abundant along the coast in the central and southern portions of the State.

Hosts.—Adults and larvæ feed upon the mealy bugs and also upon the young of other scale insects.

Hyperaspis undulata Say.

(Fig. 211.)

General Appearance.—A very small species, the adults being less than one eighth of an inch long. The body is elongate-oval and shining black. The face and sides of thorax of the male are yellow, while in the female the former is black. Each wing cover has three yellow narrow spots on the margin and one oval yellow spot near the middle.

Distribution.—A common species, especially in moist locations, throughout the State.

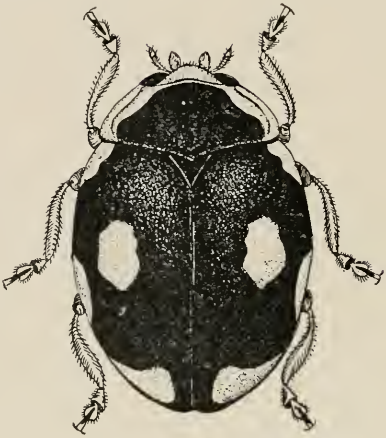

FIG. 211.—*Hyperaspis undulata* Say.
(Original. Drawing by Birdnekoff.)

Hosts.—The larvæ and adults feed upon plant lice, coccids and other small soft-bodied insects.

Hyperaspis dissoluta Cr.
(Fig. 212.)

General Appearance.—This is one of the very small species, being little more than one sixteenth of an inch long. The body is elongate-oval and quite convex; shiny black; lateral margins of wing covers with narrow broken border which may appear as three distinct spots on each side. The legs are brownish.

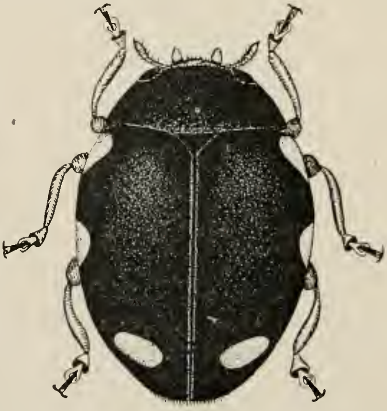

FIG. 212.—*Hyperaspis dissoluta* Cr.
(Original. Drawing by Birdnekoff.)

Distribution.—Occurs in limited numbers in southern and central parts of the State, as specimens have been collected in Alameda and Los Angeles counties.

Hosts.—Feed upon young scale insects.

Hyperaspis mœrens Lec.

(Fig. 213.)

General Appearance.—The adult beetles are very small, averaging about one tenth of an inch in length for the males and one eighth of an inch for the females. They are elongated in shape and shiny black with yellowish or reddish markings as shown in Fig. 213.

Distribution.—Common in the southern part of the State, especially in Ventura County.

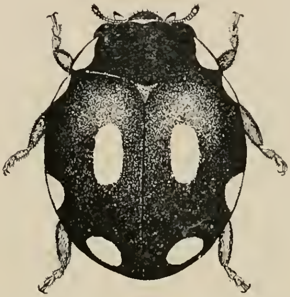

FIG. 213.—*Hyperaspis mœrens* Lec. (Original.)

Hosts.—Large numbers of this species were taken in lemon orchards where they were feeding upon young black and purple scale.

Hyperaspis spiculinota Fall.

(Fig. 214.)

General Appearance.—The largest adult beetles are about one eighth of an inch long; elongated in shape; shiny black with yellowish or reddish markings as shown in Fig. 214 and with pale legs, antennæ and palpi.

Distribution.—Limited to the southern part of the State.

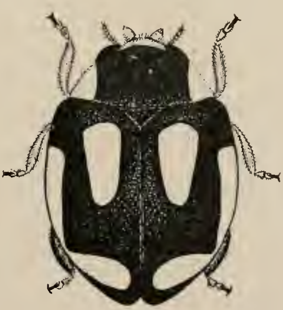

FIG. 214.—*Hyperaspis spiculinota* Fall. (Original.)

Hosts.—This species preys upon young scale insects.

THE SMALL BROWN LADYBIRD BEETLE.

Scymnus sordidus Horn.

(Fig. 215.)

General Appearance.—Very small light brown beetle, scarcely more than one eighth of an inch long.

Life History.—The eggs are very minute and deposited in suitable feeding grounds. The larvæ cover themselves with a thick coat of long white waxy flocculence and greatly resemble mealy bugs. Though small they are voracious feeders, especially upon the smaller species of plant lice and also upon young scale insects. The pupæ are formed within the old larval skins.

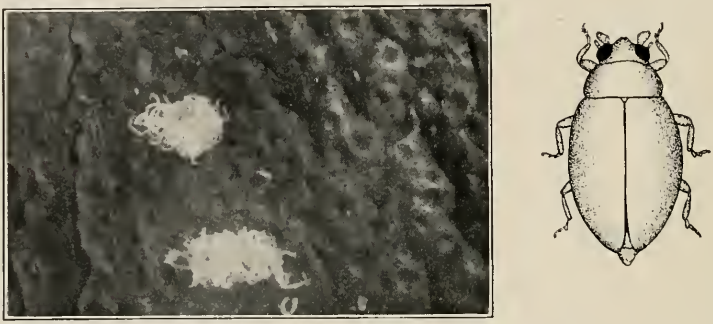

Fig. 215.—Larvæ and adult of *Scymnus sordidus* Horn. The former slightly and the latter greatly enlarged. (Essig, P. C. Jr. Ent.)

Distribution.—Throughout the entire State, but more abundant in the south.

Hosts.—This species preys upon mealy bugs, the young of the armored scales, plant lice (*Aphis gossypii*) and other soft-bodied insects. Large numbers of these ladybird beetles are to be found in the citrus groves of Ventura County.

Scymnus guttulatus Lec.

(Fig. 216.)

General Appearance.—The adult insects are oval-elongate in shape and scarcely one eighth of an inch in length. The general color is black, mottled with reddish-brown as shown in Fig. 216. The larvæ are about one fourth of an inch long with yellow bodies entirely covered with long, white, cottony filaments. (Fig. 208C.) The nymphs remain in the old larval skins in secluded quarters throughout the pupal stage.

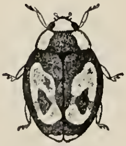

Fig. 216.—Adult of *Scymnus guttulatus* Lec. (Essig, P. C. Jr. Ent.)

Distribution.—This is a native species, occurring throughout the entire State, having been often distributed by the State Insectary.

Hosts.—The larvæ and adults work upon various native mealy bugs as well as upon the citrus mealy bug (*Pseudococcus citri*) and the long-tailed mealy bug (*Pseudococcus longispinus*).

Scymnus nebulosus Lec.

(Fig. 217.)

General Appearance.—The adult beetles are exceedingly small, being less than one eighth of an inch in length. They are somewhat elongated in shape and vary from light to dark brown in color, with indistinct dark markings. The larvæ are covered with long, white cottony filaments.

Distribution.—Throughout the southern part of the State.

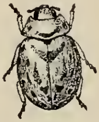

FIG. 217.—*Scymnus nebulosus* Lec. (After Quayle. Courtesy Cal. Exp. Sta.)

Hosts.—The writer has collected the larvæ of this species in large numbers in the canyons of Ventura County, where they were feeding upon a small native plant louse (*Eichochaitophorus populifolii* Essig). Quayle reports it as feeding upon red and purple scale. It also preys upon various species of mealy bugs doing effectual work upon the citrus species (*Pseudococcus citri*).

Scymnus marginicollis Mann.

(Fig. 218.)

General Appearance.—A small dull-black ladybird beetle with reddish prothorax and head—the former having a black spot at the base in the males and nearly all black at the base in the females. It is less than one eighth of an inch long and distinguished from *Lindorus lopanthæ* by its dull color, the latter being shiny.

Life History.—The young feed throughout the spring and summer. The adults which hibernate over winter begin to work early in the spring and continue until the next winter. They do nearly as much feeding as do the larvæ.

Distribution.—Throughout the entire State, especially along the coast. A native species.

Hosts.—This beetle feeds upon many species of aphids and coccids, and are especially destructive to San José scale in the north and to red and purple scales in the south.

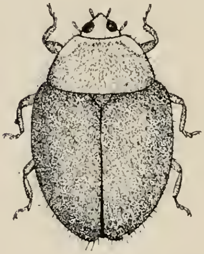

Fig. 218.—Adult female of *Scymnus marginicollis* Mann. (Essig, P. C. Jr. Ent.)

THE MINUTE BLACK LADYBIRD BEETLE.

Stethorus vagans Blackb.
(*Scymnus vagans* Blackb.)
(Fig. 219.)

General Appearance.—One of the smallest common species, so small as to be scarcely ever noticed, being scarcely one sixteenth of an inch long. Jet black in color and oblong in shape.

Life History.—The larvæ are not usually met with because of their small size and occurrence upon native shrubbery. The adults follow the infestations of mites, and feed almost entirely upon them. They are very active through the entire life history and become very numerous.

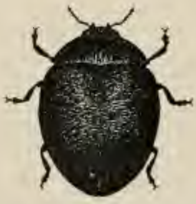

Fig. 219.—The minute black ladybird beetle, *Stethorus vagans* Blackb. (Original.)

Distribution.—A native species plentiful in the southern part of the State, and also abundant in the coast counties.

Hosts.—Small mites and spiders. Often abundant in citrus orchards, feeding upon the red spider (*Tetranychus mytilaspidis* Riley), and the common mite (*Tetranychus bimaculatus* Harv.). They also prey upon the clover mite (*Bryobia pratensis* Garman).

THE VEDALIA.

Novius cardinalis Muls.

(Fig. 220.)

General Appearance.—Slightly less than one quarter of an inch in length and oval in shape. The color pattern is very pronounced and striking, being red and black, as shown in Fig. 220. In the females red predominates while in the males there is more black. The larvæ are often over one half of an inch long and lead-gray in color with reddish sides. They are often covered with whitish powder from the egg-sacs of the cottony cushion scale.

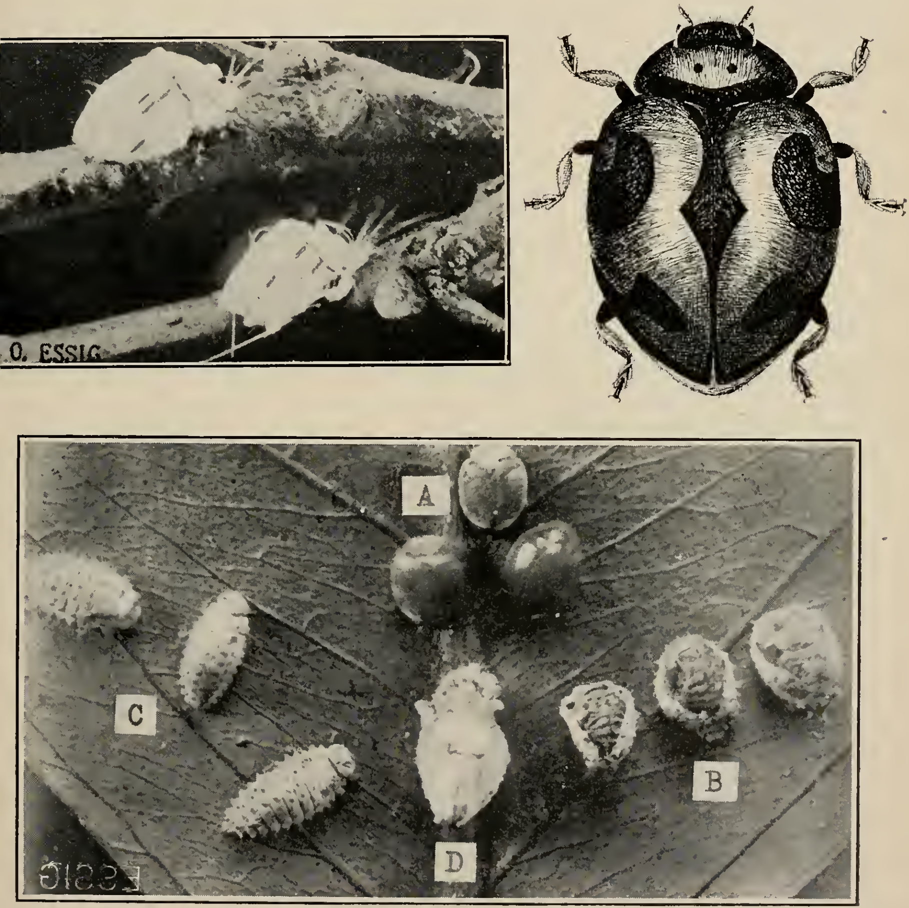

Fig. 220.—The vedalia (*Novius cardinalis* Muls.). Upper left picture shows eggs laid upon the egg-sacs of the cottony cushion scale (*Icerya purchasi* Mask.); upper right, adult beetle. In the lower picture A, adult beetles; B, pupæ; C, larvæ; D, cottony cushion scale to show comparative size. (Original. Drawing of adult by Birdnekoff.)

Life History.—The eggs are a little larger than those of *Novius kœbelei*, but are the same color and laid in similar places. The young feed upon the eggs and young scales and do great execution. The pupa stage is passed in the larval skin upon the leaves and limbs of the trees. Soon after the adult stage is reached copulation takes place and other broods are brought forth. The great prolificness and appetite of this species enables it to do what no other predator has yet done.

Distribution.—Throughout the citrus growing sections of the State. Disappears with the host and is constantly being sent out by the State Insectary. Introduced into California by Albert Kœbele.

Hosts.—It feeds entirely upon the eggs and young of the cottony cushion scale (*Icerya purchasi*). To this beetle is accredited the salvation of the citrus industry in California, which was threatened with destruction by the above scale.

KŒBELE'S LADYBIRD BEETLE.

Novius kœbelei Olliff.

(Fig. 221.)

General Appearance.—A very small species being not longer than one eighth of an inch; the males are bright red with dark markings as shown in Fig. 221; the females red with dark head, prothorax, and marginal spot near the middle of each wing cover. The larvæ are dark red and about one fourth of an inch long.

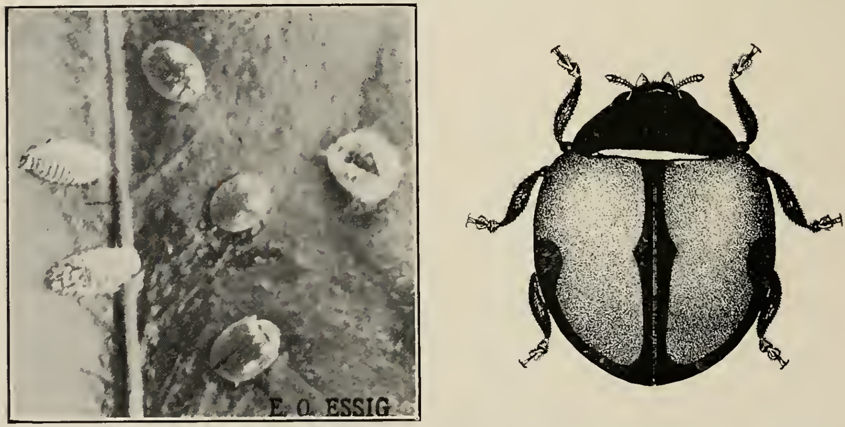

Fig. 221.—Kœbele's ladybird beetle (*Novius kœbelei* Olliff). Larvæ, pupa and adults at left. Enlarged four times. Adult male at right. Greatly enlarged. (Original. Drawing of male by Birdnekoff.)

Life History.—The small oblong red eggs are deposited by the females on the egg-sacs of the host and hatch within a few days. The young immediately enter the egg-sac and begin feeding upon the eggs and young hatched scales. They pupate within their larval skins on the trees and emerge as adults within a week or more. The adults mate and soon bring forth another brood. The females are very prolific and egg-laying continues throughout the entire spring and summer until late fall. The adults hibernate during the colder winter months.

Distribution.—Throughout the citrus growing sections of the State. It was first introduced by Albert Kœbele and is continually being redistributed by the State Insectary.

Hosts.—Cottony cushion scale (*Icerya purchasi*). This species is often more numerous and does greater execution than does the Vedalia (*Novius cardinalis*), for which it is usually mistaken.

BLACK LADYBIRD BEETLE.

Rhizobius ventralis Er.

(Fig. 222.)

General Appearance.—The adults are smaller than those of the common red ladybird; rather oval in shape; black and covered with

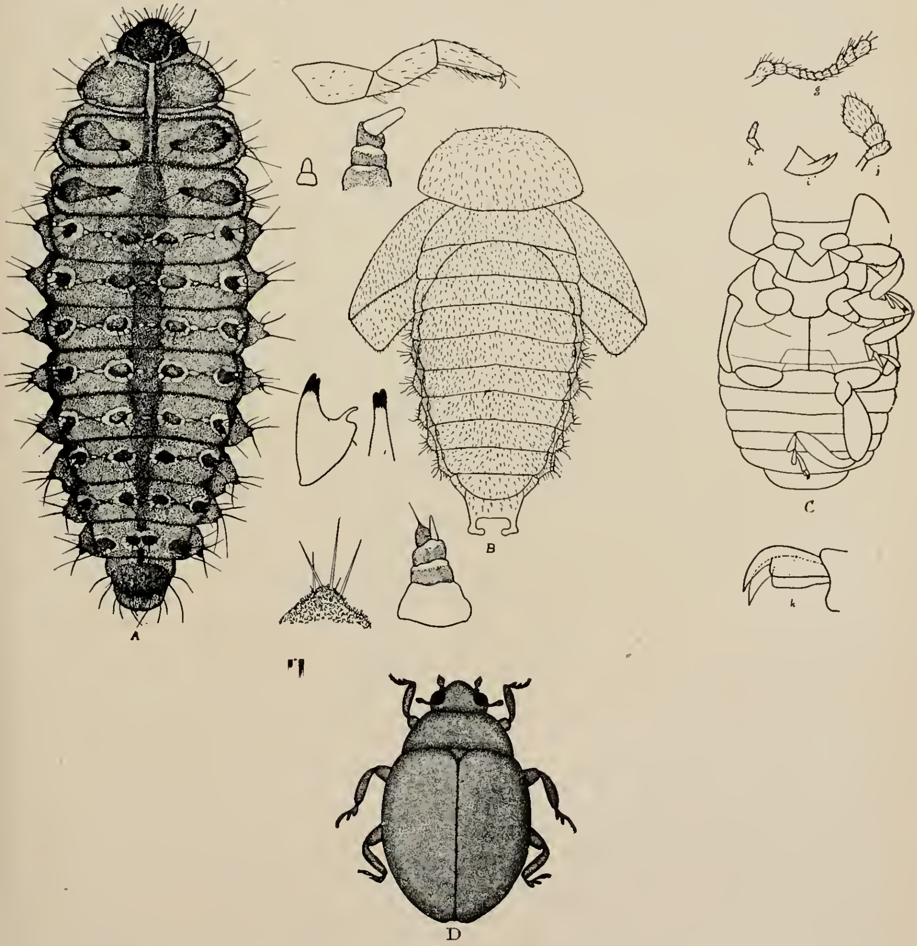

Fig. 222.—The black ladybird beetle (*Rhizobius ventralis* Er.). A, larva; B, pupa; C, ventral aspect of adult; D, dorsal aspect of adult. (Essig, P. C. Jr. Ent.)

fine hairs which give them a grayish appearance. The abdomen is salmon colored. The young are dark brown or black and covered with many spines.

Life History.—The eggs are deposited singly or a few at a place among the egg masses of mealy bugs, under the bodies of the black scale or among other scale insects. The young begin feeding as soon as they emerge upon the smaller hosts first. The numbers of the host are so great that the actual good done is not so marked as in the cases of many other predators. The adults move little except when annoyed.

Distribution.—Throughout the entire State. This species was imported by Albert Kœbele, especially as an enemy of black scale (*Saissetia oleæ*).

Hosts.—The young feed upon the eggs of the black scale, mealy bugs, hemispherical scale and other similar insects.

Lindorus lopanthæ Blaisd.

(*Rhizobius lopanthæ* Blaisd.)
(*Rhizobius toowoombæ* Blackb.)
(Fig. 223.)

General Appearance.—The adult beetles are rather broadly-oval in shape and about one eighth of an inch long. The color is bright metallic black or bronze. The head and thorax are reddish brown with a dark spot at the middle base of the latter. This species is very often confused with *Scymnus marginicollis* but may readily be distinguished from it by the lustrous bronze color. The larvæ are light brown in color with an elongated yellow spot on the middle of the back.

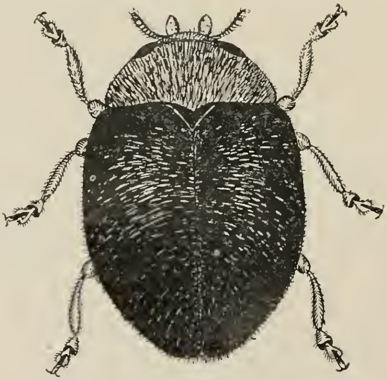

Fig. 223.—*Lindorus lopanthæ* Blaisd.
(Original. Drawing by Birdnekoff.)

Distribution.—This species was introduced into California by Albert Kœbele and has become generally established in the southern part of the State.

Hosts.—The larvæ and adults of this beetle are voracious feeders upon red scale (*Chrysomphalus aurantii*), yellow scale (*Chrysomphalus citrinus*), ivy scale (*Aspidiotus hederæ*), pernicious scale (*Aspidiotus perniciosus*), purple scale (*Lepidosaphes beckii*), the citrus mealy bug (*Pseudococcus citri*) and black scale (*Saissetia oleæ*).

THE CALIFORNIA GRAPE ROOT-WORM.

**Adoxus obscurus* Linn. (Family Chrysomelidæ).

(Figs. 224, 225.)

General Appearance.—The adult beetles are about three sixteenths of an inch long, jet black in color and partially covered with fine whitish hairs giving them a grayish cast. The prothorax is noticeably narrower than the rest of the body. The antennæ and legs are usually black, but are sometimes brown. The eggs are elongated, yellowish-white and one twenty-fifth of an inch long. The full-grown larvæ are white with brown heads and about one fourth of an inch long. The heads are usually curved in towards the ventral surface of the body. The pupæ are white and about the same size as the fully developed larvæ.

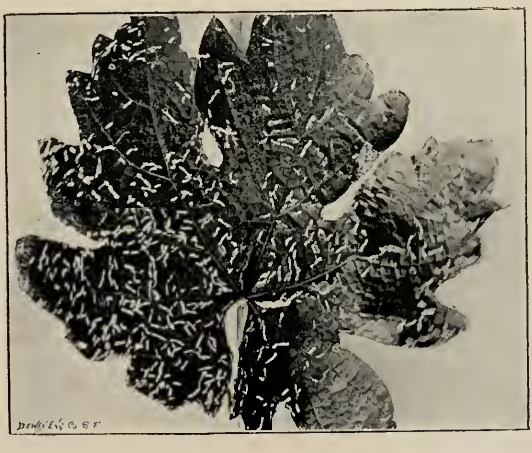

FIG. 224.—Work of the California grape root-worm (*Adoxus obscurus* Linn.) on leaf. (Cal. Hort. Com.)

Life History.—The eggs are laid early in the spring, usually in clusters of from one to two dozen in cracks or crevices beneath the bark upon the trunk of the vines, anywhere within six inches above the surface of the ground. They hatch in from eight to ten days and the young larvæ immediately seek the roots of the vines underneath the ground and attack first the small rootlets which are often entirely destroyed. The large roots are also attacked and large patches of bark removed. They continue to feed underground until fall, when they are full grown and remain dormant during the winter, transforming into delicate pupæ in the spring and after about two weeks emerge as adult insects. The larvæ and pupæ are usually found within a radius of fifteen inches from the trunks and at a depth from two feet to less. The adults appear about May to begin egg-laying and disappear in June.

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*The light-colored form has the wing covers, tibiæ and basal half of the antennæ brown, while the rest of the body is black. This species is known as *Adoxus vitis* Fourc., and the life history and habits are almost identical with those of *Adoxus obscurus* Linn.

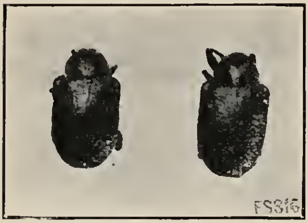

FIG. 225.—*Adoxus obscurus* Linn. (Original.)

Distribution.—This beetle occurs throughout the northern and central parts of the State, as far south as Tulare County.

Food Plants.—The larval forms work upon the roots and the adults work upon the foliage and fruit of practically all the commercial varieties of grapes.

Control.—Thorough cultivation, close to the bases of the vines, will kill many of the larvæ and pupæ. The adults may be kept in check by repeated applications of arsenical sprays. Jarring them into receptacles, containing oil, is also recommended.

THE COMMON ASPARAGUS BEETLE.

Crioceris asparagi Linn. (Family Chrysomelidæ).

(Fig. 226.)

General Appearance.—The adult beetles are slightly less than one fourth of an inch in length and very slender. The color is metallic bluish-black with red thorax marked with black dots. The reddish-yellow or cream colored wing covers are marked with black. The eggs are elongate, about one tenth of an inch long, dark brown or black and stuck to the shoots by one end. The larvæ are shiny olive gray

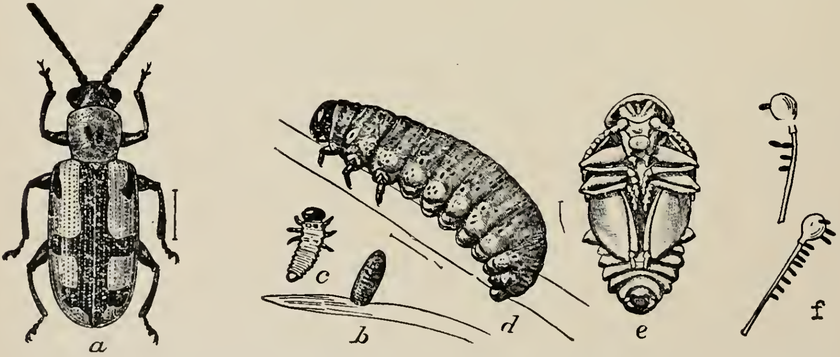

FIG. 226.—The common asparagus beetle (*Crioceris asparagi* Linn.). *a*, adult; *b*, egg on leaf; *c*, newly hatched larva; *d*, full-grown larva; *e*, pupa (all much enlarged); *f*, eggs on asparagus buds—slightly enlarged. (After Chittenden.)

with black head and legs. The pupal stage is passed in the ground in a thin cocoon, the pupæ being yellowish in color.

Life History.—The adults hibernate during the winter under any protective covering and appear in the spring about the time the young asparagus shoots are coming through the ground. The adults immediately begin to feed upon the tender sprouts and to lay their eggs upon them. The eggs hatch in about a week and the grubs begin to feed upon the sprouts. The broods continue to work throughout the summer eating all parts of the asparagus plants. After about two weeks the larvæ are ready to pupate. They then leave the plant and work into the soil where pupation takes place and within eight or nine days they emerge as adults. The entire life cycle requires about one month but there are many overlapping generations each year.

Distribution.—In the year 1904 the insect was reported as occurring at Bouldin Island, California. In 1906 it was reported to occur in great numbers at Oakley. It is now likely to be quite widely distributed throughout the central part of the State.

Food Plant.—So far as known in this State the pest feeds only upon asparagus, attacking principally the tender shoots but also working upon the rind and stems of the older seed plants.

Control.—The control of this pest is not so difficult as it would seem in view of the fact that arsenical sprays cannot be used upon the tender marketable shoots because of the poisonous effects to the consumers.

In the spring when harvesting the shoots it is advisable to leave some of them for the beetles to lay their eggs upon; cutting and burning these before the eggs hatch. Another practice is to keep all the seedlings, except a few for traps, cut down. Upon those left the beetles will collect in great numbers and may be easily killed. In the spring or after they are covered with eggs the plants should be cut down and burned.

As soon as the crop is harvested the seedlings and feathery plants should be thoroughly sprayed with arsenical sprays, which will serve to kill many of the mature beetles before they go into winter quarters. One pound of lead arsenate to sixteen gallons of water has given excellent results.

Dusting air-slacked lime of pyrethrum upon the larvæ or spraying plants infested by them with kerosene emulsion or tobacco extract are exceedingly effective as the larvæ are very delicate. Brushing to the ground also destroys large numbers of them. Burning the rubbish in the winter destroys many of the hibernating beetles.

Natural Enemies.—The young of the ladybird beetles, *Megilla maculata* and *Hippodamia convergens,* prey upon the young larvæ. In the east the spined soldier-bug (*Podisus maculiventris* Say.) and the bordered soldier-bug (*Stiretrus anchorago* Fab.) as well as certain other insects also feed upon the larvæ.

THE WESTERN TWELVE-SPOTTED CUCUMBER BEETLE.

Diabrotica soror Lec. (Family Chrysomelidæ).

(Fig. 227.)

General Appearance.—A small green black-spotted beetle about the size of, and often mistaken by farmers for a ladybird beetle. The ventral surface is entirely black. The larvæ are white and subterranean in habits, so are seldom met with.

Life History.—The eggs are laid in early spring around the bases of the food plants from one half to one fourth of an inch under the ground. They hatch quickly and the white grubs begin feeding upon the roots. The pupal cells are made near the surface and in about two weeks the adult beetles emerge. The broods overlap throughout the summer, there being two distinct generations. The adults hibernate during the winter.

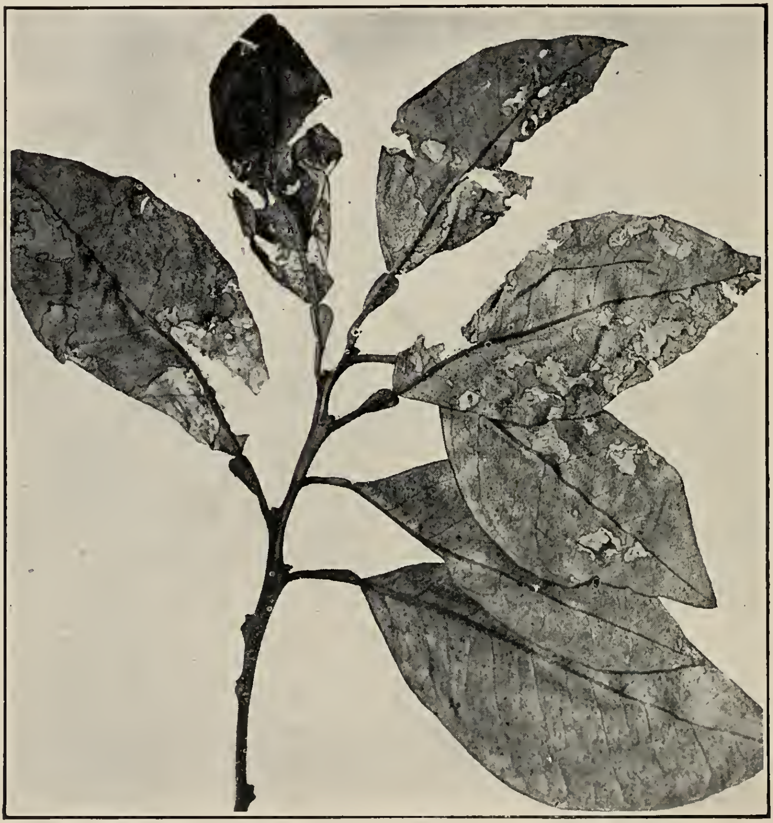

Fig. 227.—The work of the western twelve-spotted cucumber beetle (*Diabrotica soror* Lec.) on orange leaves. (After Quayle. Courtesy Cal. Exp. Sta.)

Distribution.—Throughout the entire State. One of the most common of all field insects.

Food Plants.—The adult beetles often become serious pests. During the past year much damage was reported in the central part of the State to young alfalfa in newly mown fields. The beetles also severely attack the tender foliage of citrus trees. The following other plants are subject to its ravages: beets, melons, cucumbers, squashes, beans, corn, cabbages, peas, zinnias, daisies, peanuts, potatoes, spinach, lettuce, mustard, roses and chrysanthemums.

Control.—It is seldom necessary to resort to control measures for the larval forms, though they often do much damage. For the adults, however, control measures are often urgent. Quantities of them can be shaken from the trees upon a sticky or oil screen early in the morning. Poison sprays applied to the tender growth are very effective.

Natural Enemies.—Two natural enemies prey upon this beetle; one a tachinid fly, *Celatoria diabroticæ* Shim., and the other a spider, *Xysticus gulosus* Keys.

THE STRIPED CUCUMBER BEETLE.

Diabrotica vittata Fab. (Family Chrysomelidæ).

(Fig. 228.)

General Appearance.—The adult beetles are small, measuring about two fifths of an inch in length, and half as much in width. The color is yellow above with black head and three black longitudinal stripes on the wing covers. The under surface as well as parts of the legs and antennæ are black. The larvæ are very small white grubs with head, anal and thoracic plates brown. They live in the earth. The eggs are oval in shape and bright lemon to orange in color and are laid in the soil.

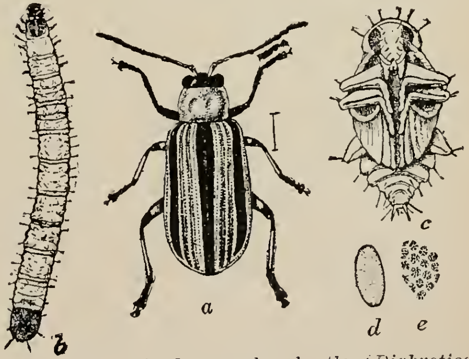

Fig. 228.—Striped cucumber beetle (*Diabrotica vittata* Fab.). a, adult beetle; b, larva; c, pupa; d, egg greatly enlarged; e, sculpture of same. All highly magnified. (After Chittenden.)

Life History.—The adult beetles hibernate over winter under rubbish or in other protected places, and emerge during the early spring months of April and May. As soon as the host plants appear the eggs are deposited in the soil around the bases and hatch in about nine days. The larvæ upon hatching feed at the base of the plants upon the roots and stems. The greatest damage is done by the adults boring down into the soil and feeding upon the tender appearing foliage. Throughout the entire summer they continue as foliage destroyers and do much damage. They also act as carriers of the bacterial wilt disease of cucumbers.

Distribution.—Throughout the State. Not as common as *Diabrotica soror* but enough so to do much damage.

Food Plants.—Squashes, cucumbers, cantaloupes, pumpkins and watermelons are its favorite food plants and suffer most from its attacks. Peas, blossoms and leaves of the apple and numerous other cultivated and wild plants are devoured.

Control.—In many instances control measures are necessary. Cheap coverings are especially desirable for small plantings and may be very practicable for extensive fields. When no coverings are used the plants may be started early in hot houses and set out after they are well established. If the plantings are made directly in the field an excess of seed should be used to allow for the destructiveness of the beetles.

Poison sprays, such as arsenate of lead or paris green aid much in controlling it, but successive applications are necessary, because of the rapid growth of the plants. The poisons are sometimes added to Bordeaux mixture and serve as a remedy for fungous diseases as well. In small patches pyrethrum is an excellent remedy.

Repellents such as land plaster or gypsum soaked in turpentine or kerosene or tobacco dust placed around the hills will tend to drive the beetles away. Bordeaux mixture is also considered a good repellent.

THE SMALL STEEL-BLUE GRAPEVINE FLEA BEETLE.

Haltica carinata Germ. (Family Chrysomelidæ).

General Appearance.—The adult beetles are less than one fourth of an inch long, metallic bluish or purplish in color with antennæ and legs black. The last ventral segment of the males has a deep elongated depression.

Life History.—The adult beetles emerge from hibernating quarters in the spring and deposit their eggs upon the vines. These hatch very soon and the young grubs begin to feed upon the foliage, completely skeletonizing the leaves. When full-grown they drop to the ground and spin a cocoon in the soil in which to pupate. The adult beetles are very active, jumping quickly when disturbed. They also fly freely.

Distribution.—This beetle has been especially abundant in the grape growing sections of the southern part of the State, where much damage has been done in years past.

Food Plants.—All stages of the pest are very destructive to the young and tender foliage of the grapevine—though they also attack various vegetables and elms.

Control.—Same as for the grape root-worm (*Adoxus obscurus*). Poisoned sprays are especially recommended for the flea beetle.

THE HOP FLEA BEETLE.

Psylliodes punctulata Melsh. (Family Chrysomelidæ).

General Appearance.—A very small, black metallic beetle with greenish tinge; oval in form; one tenth of an inch long and half as wide. The eggs are very small, oval in shape and yellow. The larvæ are small white grubs about 5 mm. long. The white pupæ as well as the larvæ are found in the soil.

Life History.—The adults appear early in the spring and are ready to attack the first hop plants as soon as they come through the ground. They feed upon the upper surfaces of the leaves, completely skeletonizing them. The vines are attacked when young and are often completely destroyed before they have reached a heighth of three or four feet. When disturbed the beetles hop or fall to the ground. They are able to make their way through the soil without much difficulty and lay their eggs upon the roots of the food plants.

The larvæ are very small and white in color with dusky markings. They live in the ground feeding upon the roots of various plants. When full grown they pupate in the soil from which the adults emerge throughout nearly the entire year, the largest number appearing from early spring to August. There are probably two generations a year.

Distribution.—Generally throughout the entire State. In the Sacramento Valley considerable damage is done to hops by this pest. It is also common in the beet fields of the southern part of the State.

Food Plants.—This species feeds upon hops, cabbage, potatoes, beets, turnips, dock, lambsquarters, pigweed, clover, rhubarb, cucumber, radish, mustard and nettle.

Control.—There have been numerous methods of control recommended for this pest. The measures directed against the hibernating beetles consist in killing all on the poles or burning up the rubbish. In the spring the first step consists in capturing the adult beetles on the young vines. A tarred board or hand hopper-dozer is used on or into which the beetles are shaken. Tanglefoot bands around the bases of the tresseled vines, as well as around the poles, not only keep the beetles from the foliage but capture great quantities of them. Various contract sprays, such as tobacco extract, emulsions, soaps, resin wash, and arsenic also have been used with good effect, but the cost due to great numbers of applications necessary, makes them almost prohibitive.

THE GRAPEVINE HOPLIA.

**Hoplia callipyge* Lec. (Family Scarabæidæ).

(Fig. 229.)

General Appearance.—The adult beetles vary from five sixteenths to three eighths of an inch in length. The head and thorax are dark brown, being the darkest portions of the entire body. They are often covered with fine golden pubescence, giving them a mottled appearance. The wing covers or elytra are brown—nearly as dark as the head and thorax or considerably lighter in some species. They are also pubescent and often appear white mottled, due to the fact that the fine hair or powder is removed in certain places. The entire ventral surface, excepting the head, is beautifully iridescent silvery green, as are also the blunt posterior end of the abdomen, the coxæ and femora of the legs. The rest of the legs and antennæ are brown. The larvæ are white grubs and live in the soil.

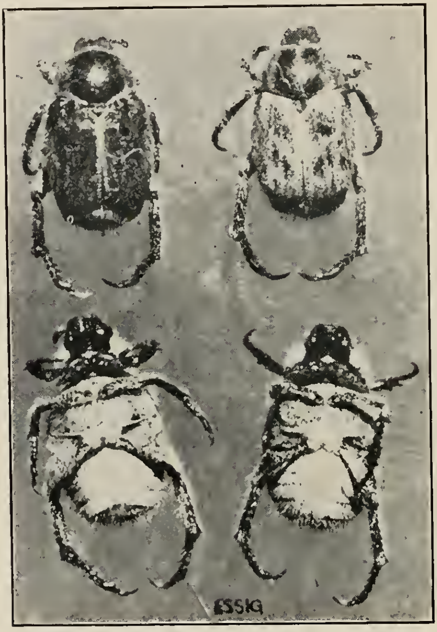

FIG. 229.—The grapevine hoplia (*Hoplia callipyge* Lec.), showing dorsal and ventral aspects.

Life History.—The life history of this beetle has not been worked out, but it probably resembles that of the other chafers. The glossy white eggs are laid in old pastures. The grubs feed upon the plant roots and grow very slowly, requiring from one to two years to become full-grown. They remain in the larval or pupal stage throughout the winter and emerge as adult beetles early in the spring and attack many kinds of vegetation.

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*Another species, *Hoplia sackenii* Lec., also occurs in the central and southern part of the State and works upon the grapevine.

Hoplia pubicollis Lec. is lighter in color than *H. callipyge* Lec. and occurs in the Sierra foothills, but apparently is not a pest.

Distribution.—This beetle seems to be most abundant in the San Joaquin Valley and more particularly to the southern part. It is also found in the southern part of the State.

Food Plants.—The usual food appears to be the young buds and older foliage of rose bushes, which often suffer greatly from the attacks. As early as 1893 it has been known to do considerable damage to the buds and leaves of grapevines. Occasionally large areas of vineyards are completely stripped. Last year considerable damage was done in Madera County. It also feeds upon greasewood.

Control.—The larval and pupal forms are found in the soil, especially in unplowed pastures and places around fences, ditches, etc. Thorough cultivation of these places will not only kill the young then present, but will keep the adults from laying eggs there. Poison sprays applied when the beetles begin to appear in considerable numbers and repeated every week will aid materially in saving the buds and foliage. Jarring the beetles into a suitable receptacle containing oil may also prove effective, especially if only small areas are badly infested.

THE BROAD-NECKED BORER.

Prionus laticollis Drury (Family Cerambycidæ).

(Fig. 230.)

General Appearance.—The adult beetles are very large, attaining a length of from one and one fourth to two inches. The color is very dark brown. The larvæ or grubs are exceedingly large, yellowish white with small reddish-brown head and a pale bluish line down the body.

Life History.—The life history of this insect has not been fully known. Adults appear late in summer about July and August, and give rise to the destructive larvæ which bore into the roots and trunks of trees and vines and work just beneath the bark. Their presence can only be ascertained after much harm has been done and the sap begins to run from the burrows. When full-grown the larvæ pupate within their burrows. The winter is passed in the larval stage, pupation not occurring until early summer, the adults emerging as indicated above.

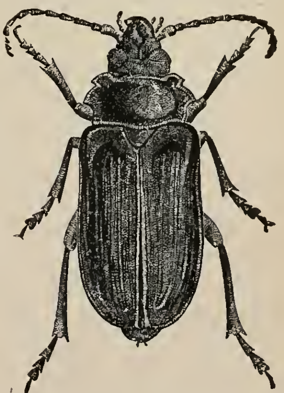

Fig. 230.—The broad-necked borer, *Prionus laticollis* Drury. (U. S. Dept. Agrcl.)

Distribution.—Found in nearly all parts of the State, but has caused damage in the southern part in particular.

Food Plants.—This beetle has become a pest to walnut trees, which are often greatly injured by the attacks of the grubs.

Control.—As the burrows are not very deep the grubs can be easily cut out or killed with a wire as soon as discovered.

ELATERIDÆ (Family).

WIREWORMS.

(Fig. 231.)

Wireworms are the larvæ or grubs of the click beetles belonging to the family *Elateridæ.* They are cylindrical in shape with hard shiny cuticle enabling them to slip easily through the soil. There are six small legs near the head and many segments. The color varies from yellow to dark brown.

In some species the larvæ develop into adults in one year while in others several years are spent in the larval stage.

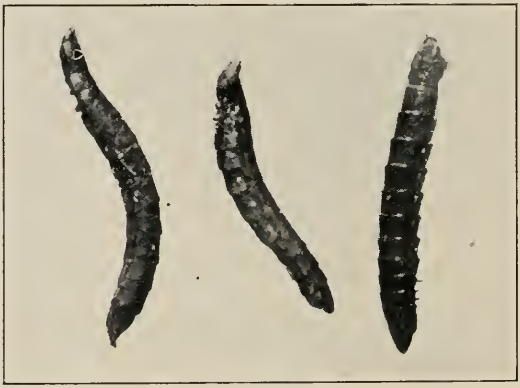

FIG. 231.—Wireworms or larvæ of the click beetles (*Elateridæ*). (Original.)

Food Plants.—Wireworms work upon the planted seed and roots of a great variety of plants destroying the former before germination and often killing the plant when it is very young, or greatly reducing its vigor. Corn, beans, beets and many other crops suffer seriously in California, while a great variety of other crops are also attacked.

Control.—The fact that the larvæ work in the soil makes control uncertain and difficult. Salty fertilizers, such as Kainit or nitrate of soda have been used with good effect as repellents to wireworms. Clean cultivation and the use of poisoned baits, such as green alfalfa treated with strychnine and placed under boards or buried in the ground are effective; poisoned slices of potatoes, carrots or other vegetables are also excellent baits.

THE FLAT-HEADED APPLE-TREE BORER.

Chrysobothris femorata Fab. (Family Buprestidæ).

(Fig. 232.)

General Appearance.—The adult beetle is oblong, flattened and the body color metallic greenish black. On each wing cover are three raised longitudinal lines which are traversed by two brass-colored depressions, dividing the surface into three nearly equal dark areas. The under side is metallic copper, and the feet green. The eggs are yellow, ribbed, but one fiftieth of an inch long and oval in form with one end flattened. The mature larvæ are dark yellow and without legs. The anterior portion, just behind the head, is enormously enlarged and flattened, giving the insect its common name, though in reality the head proper is very small and easily distinguished by the black jaws. The pupa is first white, but becomes darker until it assumes the color of the mature beetle.

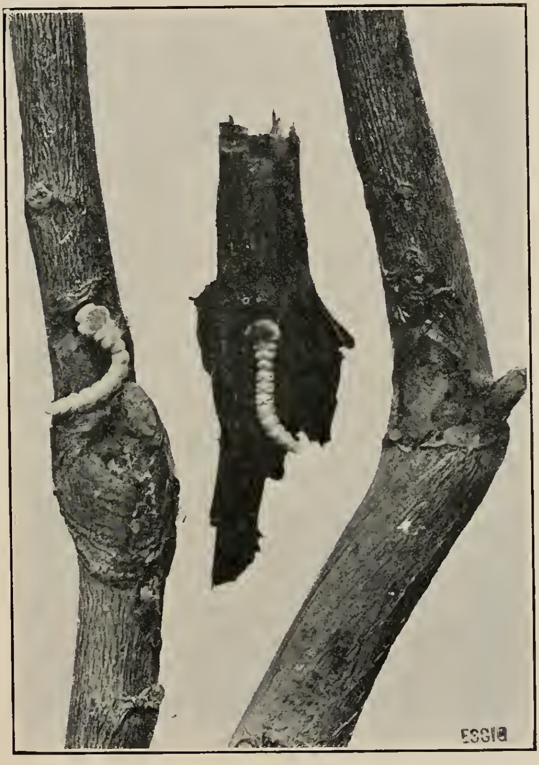

Fig. 232.—The larvæ of the flat-headed apple-tree borer (*Chrysobothris femorata* Fab.) and their work on young apple trees. (Original.)

Life History.—The eggs are fastened with a cement in the crevices and under the loose scales of the bark, either singly or in groups. After hatching the small grubs bore into the sap wood upon which they feed. Young trees may thus be completely girdled by their wide flattened burrows. As the larvæ develop they work into the older and firmer wood. When ready to pupate they work upward to the bark, eating nearly through. After pupation the adults emerge early in the spring and begin egg laying. The trees selected are usually unhealthy or are afflicted with wounds and sunburns. Upon or around such affected places the eggs are laid. The presence of the larvæ in healthy tissue may be told by the discoloration of the bark and the exudation of sap from the burrows.

Distribution.—Throughout the entire State, but causes more damage in the foothill sections.

Food Plants.—Especially injurious to weak or wounded trees, but occasionally attacks young nursery stock. It is especially destructive to the apple, but also attacks the pear, plum and occasionally the peach and raspberry.

Control.—Though this pest burrows in the trunks and limbs of large trees it is most destructive to young trees, the bases of which are often completely girdled. Therefore young trees should be protected from sunburn and injury to prevent attacks of the borer. A very good preventive is to paint the trunks and larger limbs with a solution prepared by reducing soft soap to the consistency of paint, by the addition of a strong solution of washing soda in water. This should be applied early in the spring (May or June) and again in the middle of the summer (July or August). The young burrowing larvæ may be destroyed with a knife-blade or crooked wire.

Natural Enemies.—Internal parasites play an important role in the control of this pest in the East. A small chalcid and two ichneumonid parasites (*Bracon charus* Riley and *Cryptus grallator* Say), prey upon the larvæ, while woodpeckers also dig out great numbers of them. The work of these natural enemies is responsible for its not doing more damage.

THE BEAN WEEVIL.

Acanthoscelides obtectus (Say) (Family Bruchidæ).

(*Bruchus obtectus* Say.)

(Figs. 233, 234.)

General Appearance.—The adult weevils are very short and robust, measuring about one eighth of an inch in length. The odd shape is due to the wing covers being shorter than the abdomen, and the head being carried at right angles to the body. The color varies from gray to brown with a velvety greenish tinge. The eggs are white and less than a millimeter long. The grubs are very small, a number of them being able to occupy a single small white bean. They are light cream colored and robust. The pupæ are first light, gradually becoming darker with age.

Life History.—The adult beetles after hibernating or breeding in stored beans over winter appear in the spring about the time the beans are blooming and lay their eggs upon the pods, in cracks at the end or in slits made by the female's jaws. Upon hatching the young larvæ bore through the pod or reach the beans within through a natural crack and begin to enter them by drilling a small hole, the entrance of which either heals over or is so small as to be unobserved. Once within the bean the entire life history is spent there, the adults emerging at will by cutting a circular hole in the side. The adults of the first brood immediately begin egg-laying upon the pods as did the hibernating females in the field, but if in storage bins or sacks the eggs are laid upon the seed beans or in old burrows. They thus continue to breed throughout the entire summer and winter if the weather is not too cold, many generations appearing each year.

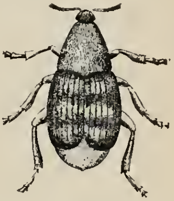

FIG. 233. — The bean weevil, *Acanthoscelides obtectus* (Say). (U. S. Dept. Agrcl.)

Distribution.—This insect is generally distributed throughout the State, and is particularly troublesome in the central and southern counties where small beans are raised.

Foods.—Nearly all varieties of beans are attacked by this weevil, though the small white and brown varieties are preferred. Limas are not usually affected, but occasionally they are attacked. Peas are also included as a host.

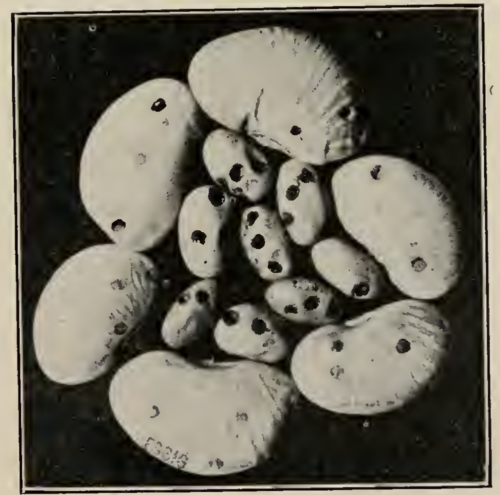

FIG. 234.—The work of the bean weevil on small white and lima beans. (Original.)

Control.—The first step in the control of this pest is to harvest the beans just as soon as possible, for those left in the fields are sure to become largely infested. If any of the insects are discovered the beans should be thoroughly fumigated with carbon bisulfid before they are stored. If weevils appear in the bins or sacks, fumigation should be resorted to at once.

THE PEA WEEVIL.

**Laria pisorum* (Linn.) (Family Bruchidæ).

(*Bruchus pisorum* Linn.)

(Fig. 235.)

General Appearance.—The adult beetles are about three eighths of an inch long, brownish black in color with well defined light spots on the wing covers and a distinct white spot on the hinder part of the thorax near the base of the wing covers. The eggs are very small (1.5 mm. long) and deep yellow in color. The larvæ are yellowish in color with a dark head. The pupæ are first light, gradually becoming darker with age.

Life History.—The adult hibernating weevils appear in the spring and as soon as the pods are formed on the vines begin egg-laying. The eggs are thrust inside of the pod by the females, thus being thoroughly protected and out of sight. The young grubs, as soon as hatched, bore into the tender peas and remain inside, drilling out sufficient room until they are ready to emerge as adults in the fall. This is accomplished by cutting a circular hole in one side of the pea. Unlike the bean weevil, this species works only upon the peas originally attacked when green and does not continue to breed upon dried and stored seed. There is but one uneven brood a year.

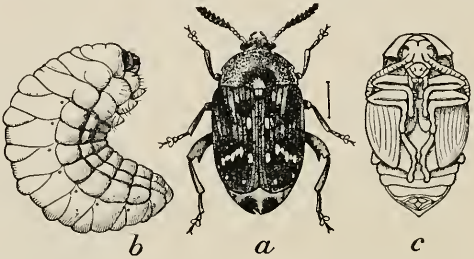

Fig. 235.—The pea weevil, *Laria pisorum* (Linn.). a, adult beetle; b, larva; c, pupa. (After Chittenden.)

Distribution.—Common throughout the State, but not troublesome in all the pea-growing sections.

Foods.—Works upon all varieties of garden and flower peas.

Control.—As the seed is infested before harvesting, control measures are of little avail, except to prevent a reinfestation by means of the seed. A thorough fumigation with carbon bisulfid is a sure way of accomplishing this.

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*Note.—The pea weevil greatly resembles the broad-bean weevil, *Laria rufimana* Boh. The principal differences are given by F. H. Chittenden in the following tabular form:

Posterior femora acutely dentate; thorax broad; pattern of elytra well defined; pygidium with a pair of distinct apical black spots----*pisorum* L.
Posterior femora obtusely or obsoletely dentate; thorax narrow; pattern of elytra more or less suffused; pygidium with black apical spots lacking or illy defined--*rufimana* Boh.

THE BROAD-BEAN WEEVIL.

Laria rufimana (Boh.) (Family Bruchidæ).

(*Bruchus rufimanus* Boh.)

(Fig. 236.)

General Appearance.—The adults are from fourteen to eighteen hundredths of an inch long and a little more than half as wide. The color is black with indefinite light markings on the elytra and pygidium. The head and antennæ are dark with the basal four joints of the latter rufous. The fore legs are rufous and piceous while the middle and hind pairs are black. The eggs are light or greenish yellow in color. The larvæ are pale yellow or white with dark heads.

Life History.—According to Chittenden the eggs are deposited singly and indiscriminately upon the outside of the pods, where they are plainly visible and are laid in the blossoms on the seed vessel before or after the pods are formed. Upon hatching the larvæ gnaw through the pod into the growing seeds, where they continue to feed until ready to transform into the pupal stage. This stage is passed within the bean and the adult emerges by cutting a circular hole in the skin. This species hibernates in the adult stage, there being but one generation a year. Egg-laying begins in March and April; hence the adults live for a period of from eight to nine months.

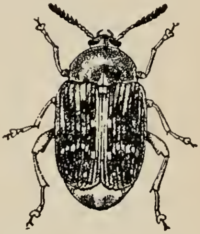

Fig. 236. — The broad-bean weevil, *Laria rufimana* (Boh.). (After Chittenden).

Distribution.—This species seems to be quite generally distributed throughout the central and southern part of the State. It has been taken by W. B. Parker at Sacramento, Berkeley, Richey, Amador County and by J. T. Condit at San Luis Obispo. It has also been taken at Watsonville.

Food.—The broad-bean weevil gets its name from its work upon the broad beans (*Vicia faba*), which are also known as horse, Windsor, tick and English dwarf beans.

Control.—While many remedies have been recommended for the control of bean and pea weevils, there is nothing that will compare with fumigation in an air-tight receptacle. Carbon bisulfid at the rate of three pounds to each one thousand cubic feet of air space for a period of forty-eight hours is recommended.

FULLER'S ROSE BEETLE.

Aramigus fulleri Horn (Family Otiorhynchidæ).

(Fig. 237.)

General Appearance.—The adults vary from gray to very dark brown in color and from three eighths to one half an inch in length. The eggs are about one twentieth of an inch long, pale yellow and laid in rows. The larvæ are milky white and without legs. The pupæ are also white.

Life History.—The eggs are laid in clusters in secluded places on the trunks of trees or at the base of the trees or plants often close to the ground. The young white grubs are subterranean in their habits, doing great damage to the roots of many plants. The adults when seen during the day are very sluggish. They have no power of flight. Much damage is done to plants by this pest unknown to the farmer, owing to the fact that the larvæ work underground and the adults feed at night.

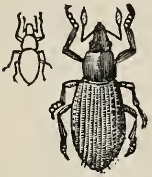

FIG. 237.—Fuller's rose weevil, *Aramigus fulleri* Horn. Natural size at left. (After Riley.)

Distribution.—Throughout the entire State, particularly harmful in the central and southern parts.

Food Plants.—Foliage of citrus trees, roses, oaks, camellias, palms, *Canna indica* and the roots of strawberries. Young or newly budded citrus trees are often greatly damaged by this pest.

Control.—The larvæ, like all subterranean pests, are difficult to control, but thorough cultivation and hoeing close to the plants are great aids. In light sandy soil, carbon bisulfid is efficient. The adults being unable to fly are easily kept from trees by means of a cotton or tanglefoot band around the trunk, but are very troublesome to low plants and bushes where such methods are impracticable. Poison sprays such as asenate of lead must be resorted to in such cases to save the foliage.

THE ROSE SNOUT BEETLE.

Rhynchites bicolor Fab. (Family Rhynchitidæ).

(Fig. 238.)

General Appearance.—A small bright red snout beetle, with head, snout and legs black. The average length of the females is about one inch. The males are noticeably smaller than the females.

Life History.—The beetles hibernate over winter in sheltered places and appear early in the spring. The females roll up the edges of the leaves into small pockets like miniature thimbles into which the eggs are laid and the young reared. The larvæ and adults feed upon the foliage, the latter also puncture the fruit of blackberries and raspberries with their snouts or bills.

Distribution—Especially abundant in the Sacramento and San Joaquin valleys and in the Sierra foothills.

Food Plants.—The beetles confine their attacks almost wholly to the wild rose, though they may occasionally work great damage to cultivated roses and to berries. The adults also feed upon oak leaves and grapevines.

Control.—As this pest is normally a leaf eater it may be controlled by liberal applications of arsenical sprays. These meet all requirements, except where they damage the fruit of berries, but even such attacks could have been prevented by spraying the vines before the berries began to ripen.

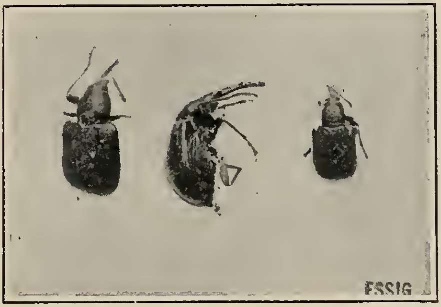

FIG. 238.—The rose snout beetle (*Rhynchites bicolor* Fab.). The two left individuals are females; the right, a male. All slightly enlarged. (Original.)

DIPTERA (Order).

TWO-WINGED INSECTS.

TRUE FLIES.

This order probably comprises more numbers than any other and is one of vast importance to health as well as to agriculture. Most of the members are injurious, though certain ones, due to their predaceous and parasitic habits in the subjection of other injurious insects are beneficial, but these are of little consequence in consideration of the great numbers of their pestiferous relatives.

The members of this order are particularly characterized by having only two wings, if wings are present at all. The male coccids and a few May flies are the only other insects being thus characterized.

All have complete metamorphosis, the larvæ being legless and headless maggots and the pupæ with free limbs or enclosed in a skin. In either case the latter are known as puparia. The mouth parts are for lapping and piercing and sucking.

The life histories and habits of flies vary considerably. Most species lay eggs while a few give birth to living larvæ, and still others bring forth young developed to the puparia stage, the latter being usually parasitic. The maggots feed upon plant tissue, fruits and flesh, and are adapted either for living upon land or in the water. The puparia may be formed in the home of the larvæ, but they are usually found in the soil. The adults are exceedingly numerous, and, with the exception of the mosquitoes, are diurnal in habits, preferring bright sunshine.

The control of this group is very difficult, due to the great productiveness of the females and the secluded work of the larvæ. A contact spray is usually recommended for sucking insects, but are of little avail against the maggots, while poison baits and sprays are readily lapped up by adult flies and give some aid as control measures. The reduction of the number of maggots is only accomplished by the destruction of the adults.

Natural enemies play an important role in checking the tremendous increase of a great many species. Predaceous insects prey upon the larvæ and adults while internal parasites attack nearly all stages.

The classification of this large order is very complicated, being composed of many suborders, families and subfamilies, so that no attempt will be made to designate any but those which are of economic importance to the agriculturists in California.

THE ALFALFA CRANE-FLY.

Tipula simplex Doane (Family Tipulidæ).

(Figs. 239, 240.)

General Appearance.—The adults are long-legged, slender-bodied insects of a light brown color. The females are wingless while the males are winged and somewhat smaller, lighter in color and with longer, frailer legs. The average length of the adult female is about one half of an inch.

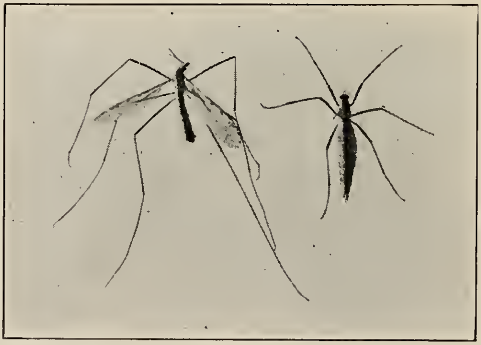

FIG. 239.—Adult male and female of the alfalfa crane-fly, *Tipula simplex* Doane. (After Carnes and Newcomer.)

Life History.—The small, oval, dark gray eggs are deposited as deeply into the soil as the length of the female's abdomen will allow. They are laid throughout the early spring and summer. These soon hatch into light colored maggots, which begin to feed upon the roots of plants. When full grown they are from three fourths to nearly an inch in length—the color being a very dark brown. The maggots remain in moist or wet places, breathing water through spiracles at the posterior end. The pupæ greatly resemble the larvæ in shape and color until nearly time to develop into the adults, when the wings and legs begin to appear. The body segments are provided with sharp spines which project backwards and by which they are able to wriggle to the surface when ready to emerge. The broods overlap so that all stages may be found. The insect probably hibernates in the larval forms and pupate early in the spring, giving rise to the adults. These bring forth young larvæ, which become destructive early in the summer.

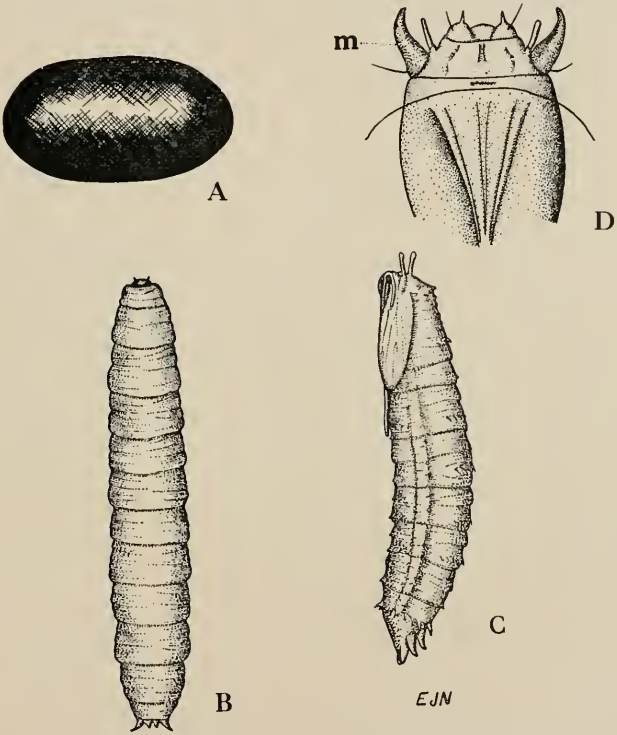

FIG. 240.—The alfalfa crane-fly. A, egg; B, larva; C, pupa; D, head of larva. (Drawing by Newcomer.)

Distribution.—This insect is common in the central and northern parts of the State.

Food Plants.—The larvæ feed entirely upon the roots of plants. Undoubtedly a great variety are attacked. Serious damage has been reported, due to its ravages in alfalfa and clover fields.

Control.—The greatest amount of damage is usually done in fields which have long been seeded to alfalfa or clover, where the breeding has not been disturbed. Plowing and thorough cultivation will destroy most of the larvæ, which are either crushed or die for lack of sufficient moisture. The females being wingless are unable to migrate sufficiently to cause serious damage in one year. A cultivated crop once in two or three years as a rotation with clover or alfalfa is recommended when the destructiveness of the pest warrants strict remedial measures.

Natural Enemies.—Carnes and Newcomer report a tachinid fly as parasitic upon the larvæ.

THE HESSIAN FLY.

Mayetiola destructor (Say) (Family Cecidomyiidæ).

(*Cecidomyia destructor* Say.)

(Fig. 241.)

General Appearance.—This insect when fully developed is a small brown fly about one tenth of an inch in length. The eggs are about

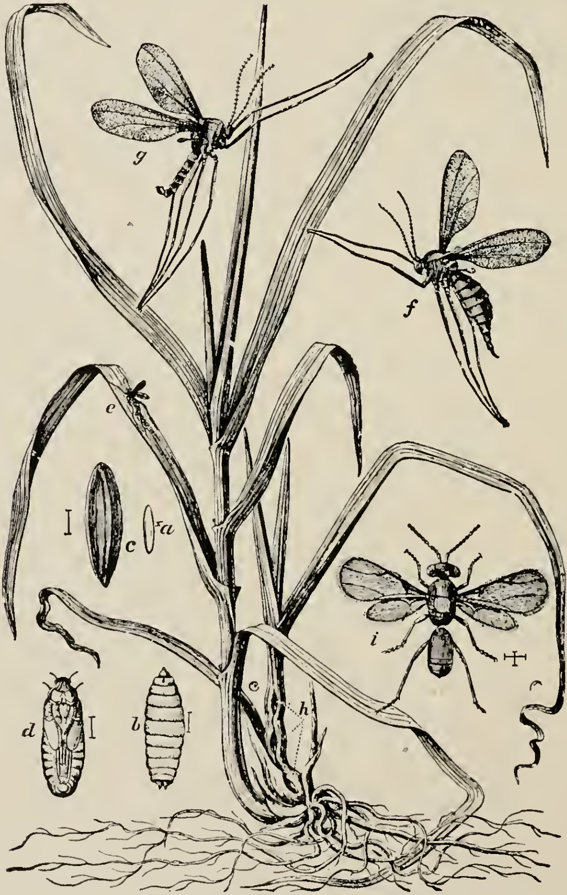

FIG. 241.—The Hessian fly, *Mayetiola destructor* (Say). Healthy wheat stock at left and infested stock at right; *a*, egg; *b*, larva; *c*, puparium or "flaxseed"; *d*, pupa exposed; *e*, adult female laying eggs; *f*, female; *g*, male; *h*, puparia or "flaxseed" in natural position between leaves and stalk; *i*, parasite (*Merisus destructor*). (Slightly enlarged, excepting *e*, which is smaller than natural.) (After Riley, Burgess and Forbes.)

one fiftieth of an inch long, cylindrical and shining red. The maggots are greenish-white in color and work between the sheaths and stems of the host. The puparia are rich brown and located among the roots at the bases of the plants.

Life History.—The adults appear in the fall and deposit their eggs upon the stems of the young growing wheat as soon as it is well above the ground. The larvæ work between the blade sheath and stem during the winter, changing to puparia in the spring and to adults a little later. These adults, known as the spring brood, lay eggs in the growing stalks, weakening and causing them to fall. After the grain is cut the maggots remain in the stubble, transforming into adults, known as the fall brood, which lay their eggs upon the young growing wheat.

Distribution.—This insect was introduced into the central part of the State many years ago but for some reason has spread very little and in no sense become at all a serious pest.

Food Plants.—Wheat is the crop most seriously injured by this pest and the damage done to that crop in the central wheat-growing states has been tremendous. It also works on *Elymus* sp. and *Agrostis* sp.

Control.—Fortunately the ravages of this fly in California have not been great and it is to be hoped that it will never become a serious pest here. Control is extremely difficult, consisting in burning and plowing under the stubble as soon as the wheat is cut and planting as late in the fall as possible. Early trap crops of wheat are also planted about August. Such crops attract the flies and after the eggs are laid they are plowed under, destroying the oncoming broods.

Natural Enemies.—Parasites also play an important part in the control of the pest. In the Eastern States the parasite, *Merisus destructor* works upon it. The internal parasite, *Semiotellus destructor,* has been bred from the fly in California.

SYRPHIDÆ.

FLOWER, HONEY OR SWEAT FLIES.

Always among the plant lice are to be found greenish, flat, sticky-looking "worms" which are decidedly pointed at one end and do not have distinct head, eyes or legs. These so-called "worms" are the larvæ or maggots of flies belonging to the family *Syrphidæ,* which are commonly called syrphid or flower-flies. The larvæ vary from the minutest first-hatched maggot to nearly an inch in length, according to the species to which they belong. They are usually light or dark green, but some may be brown, orange, very light or nearly black. Those feeding upon plant lice and herein described are green with a longitudinal darker green or brownish stripe on the dorsum. The mouth is situated at the small end and all of the food is obtained by puncturing the body walls of the lice and then sucking out the contents. This operation is easily observed in the field. The maggot firmly supports itself by the large posterior end, raises itself up and begins to blindly move its mouth-end about in quest of food. If it touches a plant louse it immediately lifts it into the air and sucks it dry. This is very rapidly repeated, with very disastrous results to the lice. When the larva is full grown it seeks some sheltered spot in which to pupate (transform into the adult fly). This it may do on the stems or upon the surface of a leaf. The puparium is a long, roundish, or oval, brown body, showing no signs of life. The adult fly removes one end of the case to escape. The adults are usually dark with transverse yellow bands across the abdomen. They are very swift fliers and are often mistaken for bees. They are common around flowers, feeding upon the nectar and from this habit get the names "flower or honey flies." On hot days they are sometimes very numerous and are called "sweat flies" in the Eastern States. They deposit their eggs singly upon leaves and twigs which are infested with plant lice and these give rise to the green larvæ.

While these insects do much to prevent the spread of the plant lice, they are in turn preyed upon by other insects. Ants, which foster and protect the plant lice, kill and carry off the larvæ in large numbers and greatly reduce their efficiency. Internal parasites also prey upon them.

There are three species here which are doing good work in keeping down plant lice: a very large species, *Lasiophthicus pyrastri* Linn., the American syrphid, *Syrphus americanus* Wied. and the small species *Allograpta obliqua* Say.

THE LARGE SYRPHID FLY.

Lasiophthicus pyrastri Linn.

(Fig. 242.)

General Appearance.—This is one of the larger syrphid flies, being nearly one half of an inch long. The large compound eyes occupy most of the head and are dark Indian red or brown. The face is yellow and hairy, with median dark line; antennæ are black with long dorsal arista; thorax iridescent dark blue or green, covered with long, fine hairs or pubescence; scutellum same color as the mesothorax; legs—coxæ dark; femora dark with tips light; tibiæ amber or yellowish, slightly darker at tips; tarsi dusky; abdomen velvety black with three pairs of marginal curved transverse bands on the dorsum. These bands do not come together in the middle and so really form six broken bands. The eggs are very small and white. The larvæ, when full-grown, are nearly three fourths of an inch long and vary from light green to light brown in color. The puparia are brown.

Distribution.—This is an exceedingly common species found all over the State.

Hosts.—The larvæ appear to make little or no distinctions as to aphid species and feed upon a great many, among which are: the green citrus aphid (*Macrosiphum citrifolii* Ashm.), the orange aphid (*Toxoptera aurantiæ* Koch), the melon aphis (*Aphis gossypii* Glover) and the black peach aphis (*Aphis persicæ-niger* Smith).

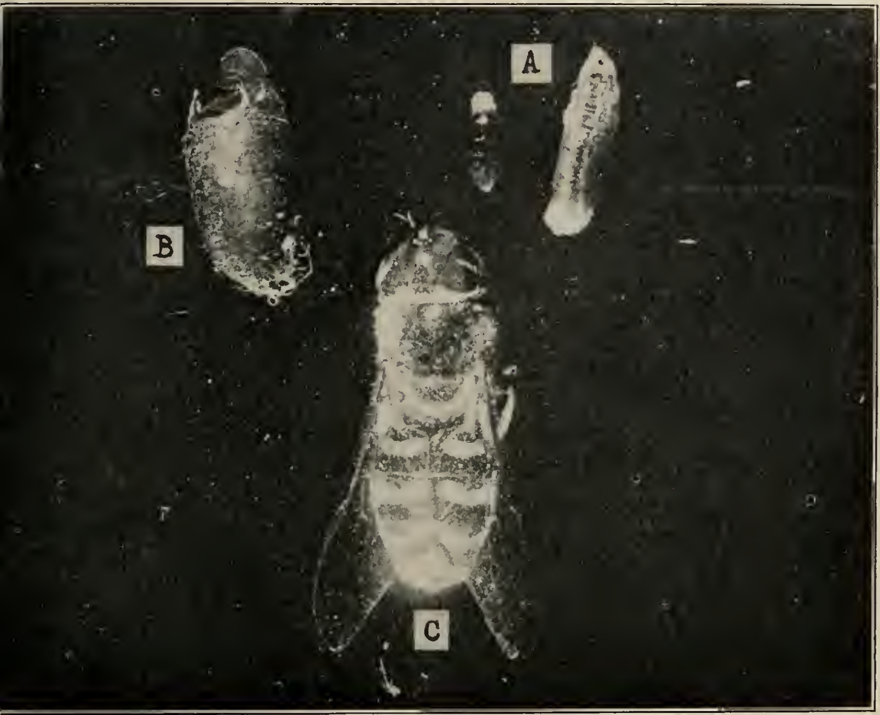

FIG. 242.—The large syrphid fly (*Lasiophthicus pyrastri* Linn.). A, larvæ; B, puparium from which adult has emerged; C, adult. (Essig, P. C. Jr. Ent.)

THE AMERICAN SYRPHID FLY.

Syrphus americanus Wied.

(Fig. 243.)

General Appearance.—In general this species greatly resembles *Lasiophthicus pyrastri* Linn. in shape and color, though it is somewhat smaller. The eyes are dark reddish-brown; face amber yellow with a dark band in the middle extending from the base of the antennæ to the mouth; antennæ black, with dorsal arista; thorax iridescent green, covered with fine, long hair; legs amber with bases dark; abdomen rich, shiny black with three pairs of transverse yellow broken bands along the dorsal margins. These bands do not unite in the middle by one half their lengths. There are also two very narrow transverse yellow bands extending across the dorsum near the posterior end of the abdomen.

Distribution.—Very common in all sections of the State.

Hosts.—The larvæ feed upon a great number of plant lice, including the black peach aphis (*Aphis persicæ-niger* Smith), the melon aphis (*Aphis gossypii* Glover), the green citrus aphid (*Macrosiphum citrifolii* Ashm.), the orange aphid (*Toxoptera aurantiæ* Koch).

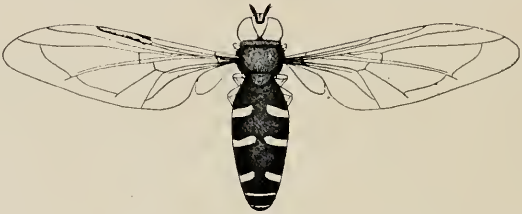

Fig. 243.—The American syrphid fly, *Syrphus americanus* Wied. (Essig, P. C. Jr. Ent.)

THE SMALL SYRPHID FLY.

Allograpta obliqua Say.

(Fig. 244.)

General Appearance.—This is one of the smallest syrphid flies met with in the State, being seldom over one fourth of an inch long. The body is slender; eyes dark red; face yellow with dark median line; antennæ amber brown; thorax iridescent green; scutellum and legs light yellow; abdomen dark with four transverse yellow bands on the dorsum, and yellow longitudinal markings at the base of the amber or dark brown abdominal tip.

Distribution.—This is one of the most widely distributed and common species found in the State, being present in practically every locality.

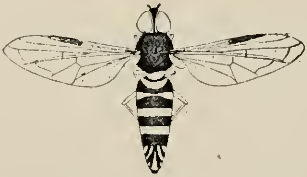

Fig. 244.—The small syrphid fly, *Allograpta obliqua* Say. (Essig, P. C. Jr. Ent.)

Hosts.—The larvæ of this fly works upon a great number of different lice and adults have been bred from those feeding upon the corn-leaf aphis (*Aphis maidis* Fitch.), the orange aphid (*Toxoptera aurantiæ* Koch), the melon aphis (*Aphis gossypii* Glover).

THE CANTALOUPE FLY.

Euxesta notata Wied. (Family Ortalidæ).

(Fig. 245.)

General Appearance.—The adult flies are slightly over one eighth of an inch long, beautiful metallic green in color with eyes dark brown. The wings are transparent with a distinct black spot near the middle of the front margin and a similar spot near the tip of each. The maggots vary from white to dusky brown, the blunt end being often darker than the rest of the body. They are about one fourth of an inch long when fully matured.

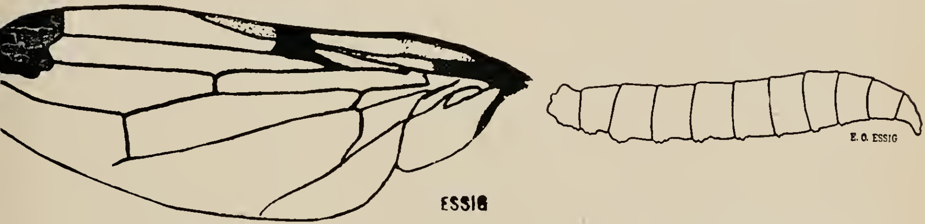

FIG. 245.—The cantaloupe fly (*Euxesta notata* Wied.). Wing and maggot. Enlarged five times. (Original.)

Life History.—The eggs are laid in the tissues of injured or damaged fruits and vegetables and while the maggots work principally upon such tissue they are often found in sound and living portions and occasionally in apparently uninjured fruits. The pupæ are found in the decayed hosts or in the soil, the adults emerging in a very short time. Due to the peculiar habits of the larvæ, they have often been mistaken for the maggots of the true fruit flies of the family *Trypetidæ* and have been the occasion of great alarm.

Distribution.—Occur quite commonly over the State, but are more abundant in the warmer sections of the central and southern parts.

Foods.—This species caused considerable alarm some years ago when it was found working upon cantaloupes in Tulare County, but investigation showed that only the injured or decayed melons were attacked. No less anxiety was aroused this summer when maggots were found in apparently sound oranges in Los Angeles County, but they also proved to be of this harmless fly. According to Prof. J. M. Aldrich the maggots are also known to attack onions, osage orange, cotton bolls, sumach fruits, berries of *Solanum carolinense* and apple.

THE DIPTEROUS PARASITE OF THE COTTONY CUSHION SCALE.

Cryptochætum iceryæ Will. (Family Agromyzidæ).

(*Lestophonus iceryæ* Will.)

(Fig. 246.)

General Appearance.—The adults of this very beneficial insect are exceedingly small two-winged flies about one sixteenth of an inch long. The head and thorax are metallic blue and the abdomen bright iridescent green. The antennæ are black; legs black or dark brown with feet light; wings grayish hyaline with dark brown veins.

Life History.—The eggs are deposited by the females in the egg-sacs of the cottony cushion scale and the young maggots feed upon the eggs of this pest. The entire life history is passed within the protecting sac of the host, the adults emerging as by magic from the masses of the scale.

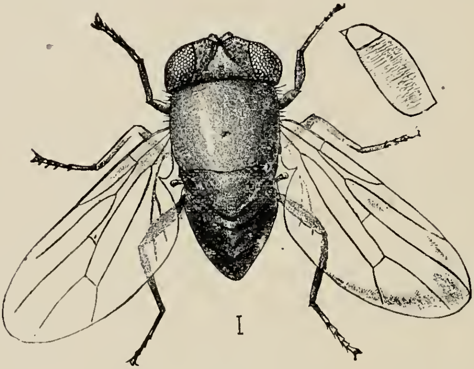

Fig. 246.—The dipterous parasite (*Cryptochætum iceryæ* Will.) of the cottony cushion scale. Adult and egg. Very greatly enlarged. (After Williston.)

Distribution.—This fly is practically confined to the citrus-growing sections of Southern California and is more often found in Los Angeles, Orange and San Diego counties.

While it is not as consistent and reliable in its work upon the cottony cushion scale as are the ladybird beetles (*Novius cardinalis* and *N. kœbelei*) yet its work is often phenomenal. During the summer of 1912 Mr. A. S. Hoyt, Deputy State Quarantine Officer, bred quantities of this species in Los Angeles County. He believes that the fly is often responsible for the good name of the Vedalia. Certainly its rearing and distribution is well worth while.

THE ASPARAGUS MINER.

Agromyza simplex Loew (Family Agromyzidæ).

(Fig. 247.)

General Appearance.—The adult flies have a wing expanse of about one-sixth of an inch and are metallic-black in color. The maggots are one fifth of an inch long and white. The puparia are one seventh of an inch long and red.

Life History.—The first adult insects appear early in the spring, other broods appearing later. The larvæ mine beneath the epidermus of the stalks near the bases and may penetrate eight inches underground. The injury is often so severe as to completely girdle the stems and thus do much damage. The puparia are formed in the burrows, especially on the roots and bases of the stalks. There are at least two generations each year.

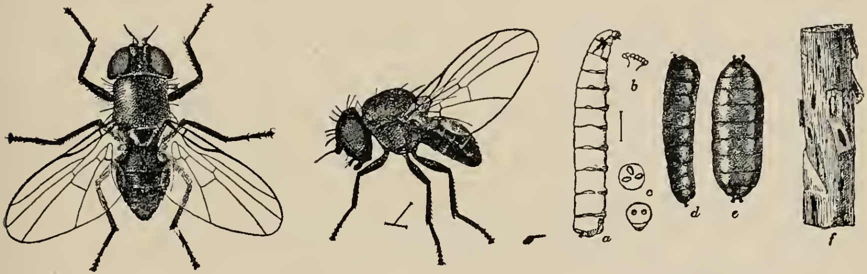

Fig. 247.—The asparagus miner (*Agromyza simplex* Loew). Adult flies at left and immature forms at right as follows: *a*, larva, lateral view; *b*, thoracic spiracles, and *c*, anal spiracles of larva; *d*, side view and *e*, top view of puparium; *f*, section of asparagus stock, showing injury and location of puparia. All much enlarged except *f* which is slightly reduced. (After Chittenden.)

Distribution.—This fly has been reported by Mr. I. J. Condit of the United States Department of Agriculture at Antioch, in Contra Costa County, and at Oakley. It appears to be generally distributed in the central part of the State.

Food Plant.—This pest works only upon asparagus plants.

Control.—The control of the fly is somewhat difficult and consists in the use of trap crops early in the spring, which should be removed, roots and all, and burned in June. Other traps should be allowed to grow up immediately and similarly destroyed in the fall.

Cutting out all infested stalks as often as they appear is also advisable.

DROSOPHILIDÆ (Family).

THE LESSER FRUIT FLIES.

(Figs. 248-252.)

Though the members of this family are of little or no importance, they are considered here so as to clear up the numerous misapprehensions that the larvæ of these small flies are not those of the true fruit flies (*Trypetidæ*). We have received great numbers of the maggots with inquiries concerning them. The larvæ work upon soured or decayed fruits and vegetables and are commonly taken on shipments of bananas, thus the reason for mistaken conclusions.

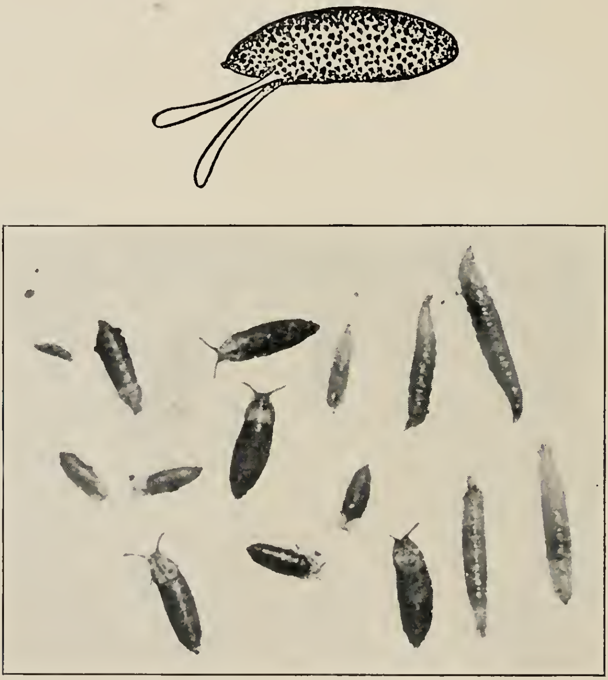

Fig. 248.—The egg of *Drosophila ampelophila* Loew at top, greatly enlarged. Larvæ and pupæ at bottom. (Original.)

The adults are usually small, yellowish flies with bright red eyes. They are common throughout the entire summer, hovering around pickled, preserved or sound fruits, decayed vegetables, etc., though the larvæ of one species is a leaf miner. A typical insect illustrating the habits and life history is the lesser fruit fly, a description of which follows.

THE LESSER FRUIT FLY.

Drosophila ampelophila Loew.

(Figs. 248-251.)

General Appearance.—Very small, amber to reddish in color, with bright red eyes. The posterior tip of the abdomen of the males is dark. The maggots are white. The puparia have two prominent posterior tubercles not unlike horns and vary from yellow to brown in color. This species can always be distinguished from all others by the comb of black spines on the upper side of the front metatarsus near the tip of the male.

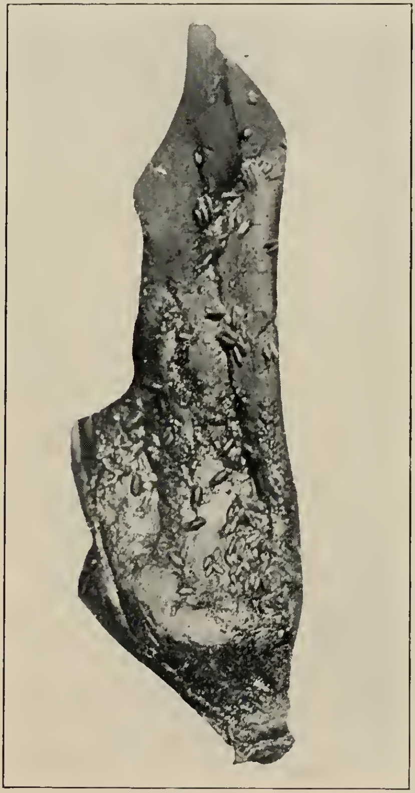

FIG. 249.—Puparia and maggots of *Drosophila ampelophila* Loew on soured banana peel. Natural size. (Original.)

Life History.—The eggs are deposited in suitable feeding places for maggots, on canned, pickled or soured fruit. The maggots work upon the above fruits until they are ready to pupate. This takes place among the refuse, the adults appearing within a few days. The entire life history seldom covers more than fifteen or twenty days.

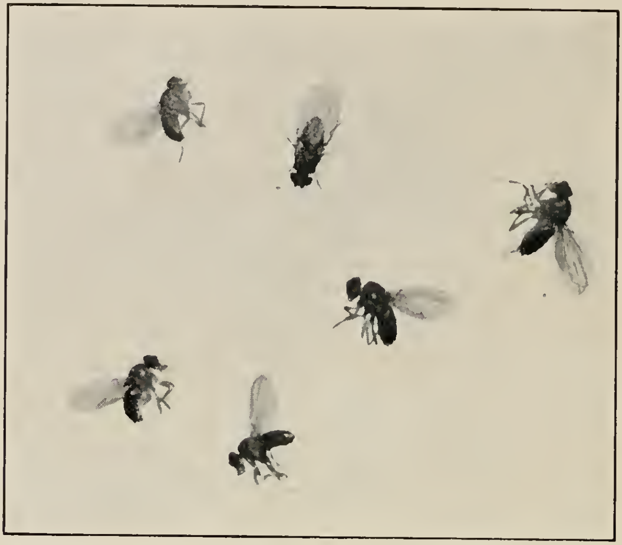

FIG. 250.—Adults of *Drosophila ampelophila* Loew. Enlarged twice. (Original.)

Distribution.—Common everywhere throughout the State.

Food.—Canned, pickled or soured fruits. The writer bred this species from pickled figs and soured bananas.

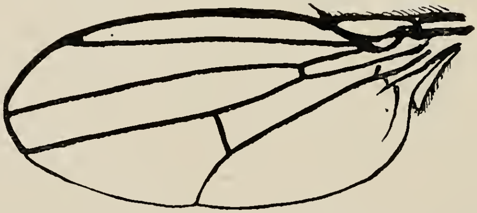

*FIG. 251.—The wing of *Drosophila ampelophila* Loew. Greatly enlarged. (Original.)

Control.—Remedial measures are seldom necessary. It is advisable to keep pickled fruits securely covered to prevent entrance of the flies.

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*The wings of the three species of *Drosophila* are drawn on the same scale for comparison.

Drosophila busckii Coq.

(Fig. 252.)

General Appearance.—This species greatly resembles *Drosophila ampelophila,* but is smaller. The general color is light reddish yellow, the abdomen being transversely striped with fine dark lines.

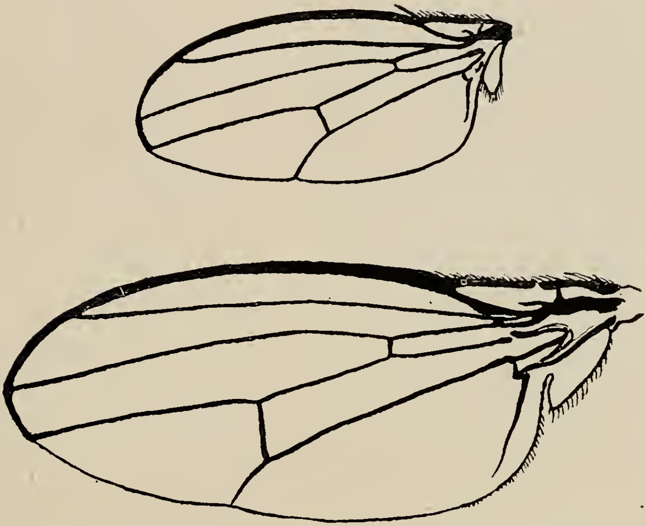

FIG. 252.—Wing of *Drosophila busckii* Coq. at top. Wing of *D repleta* Woll. at bottom. Greatly enlarged. (Original.)

Distribution.—Widely distributed over the entire State.

Food.—Specimens were reared from decaying squash in Ventura County. They have also been reared from spoiled bananas and potatoes.

Drosophila repleta Woll.

(*Drosophila punctulata* Loew.)

(Fig. 252.)

General Appearance.—This species is considerably larger than the two previously described, being about one eighth of an inch long and rather robust. The bodies are considerably darker, the abdomens being heavily striped with black.

Distribution.—This is a tropical species which is probably introduced with practically every shipment of bananas and may be found in any part of the State. The specimens bred out by the writer were from Central American bananas shipped to the office from a small town in Siskiyou County by the County Commissioner there.

Food.—Works upon soured and decaying bananas.

THE CABBAGE OR RADISH MAGGOT.

Phorbia brassicæ Bouché (Family Anthomyidæ).

(Figs. 253-255.)

General Appearance.—The adult flies are greenish-brown in color and slightly larger than the common house flies. The maggots are white or cream colored and only about one half inch long. They are found in cabbage stems or in radishes, turnips, etc. The pupæ are smooth, elongate-oval and rich reddish brown in color. They are located in the old burrows or more often in the soil.

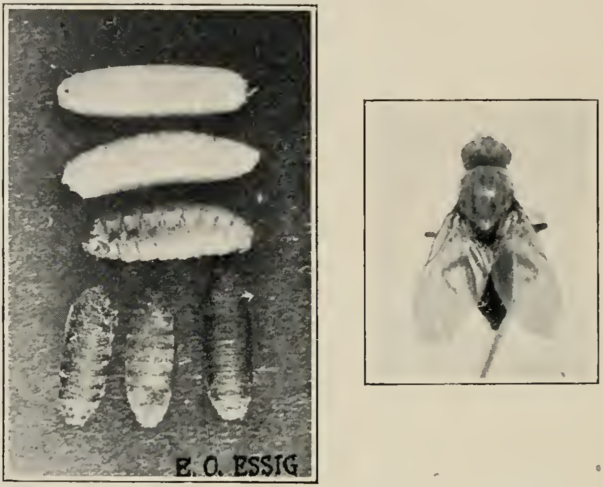

Fig. 253.—The cabbage maggot (*Phorbia brassicæ* Bouché). Larvæ and puparia at left and adult at right. (Original.)

Life History.—The eggs of this fly are laid near the root in the soil in the spring after the plants have come up in the fields or after they have been transplanted. The small maggots begin to bore into the root of the plant as soon as hatched and remain inside throughout the larval

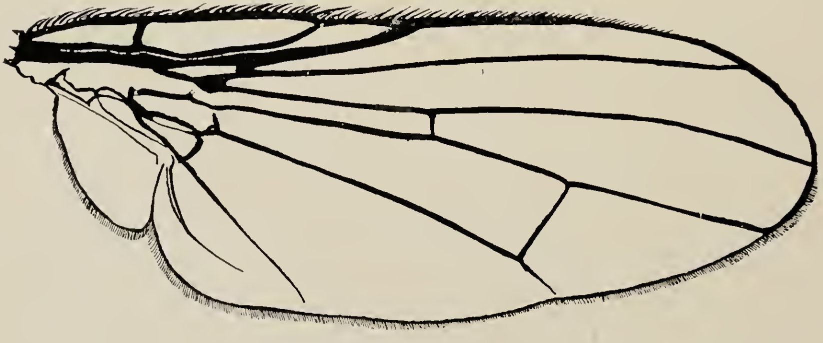

Fig. 254.—Wing of the cabbage maggot, *Phorbia brassicæ* Bouché. (Original.)

period, making numerous burrows, causing rot and injury to the plant. In about three weeks they are ready to pupate either in the old burrows or in the soil. They form a smooth brown puparia from which the adult flies emerge in one or two weeks and at once begin to lay eggs for another brood. The winters are passed in the pupal and adult stages. There are several generations a year.

Distribution.—This insect occurs as a pest particularly in the northern part of the State, but its distribution is wide.

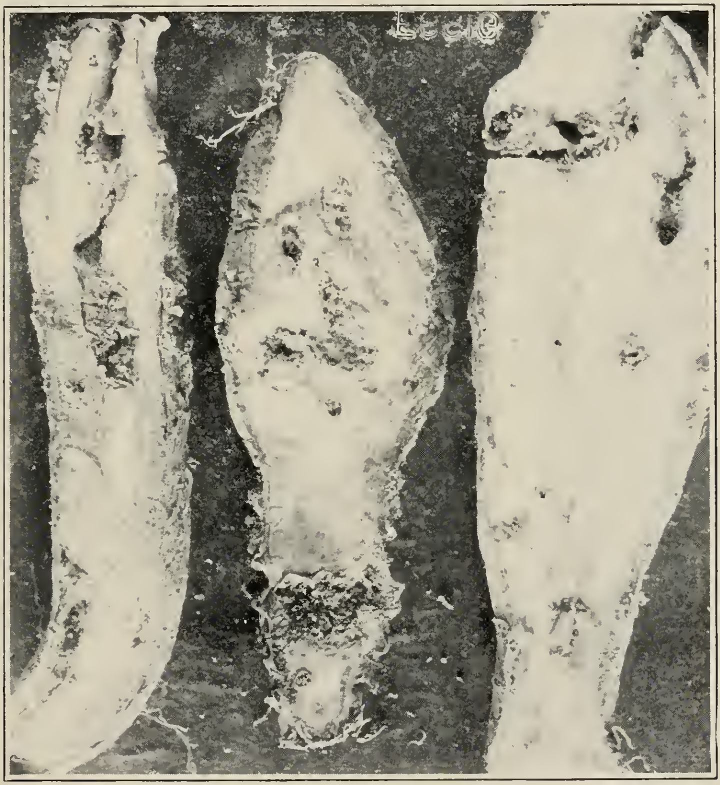

FIG. 255.—Work of the cabbage maggot on Swedish turnips. (Original.)

Food Plants.—The maggots burrow into the roots of many of the cruciferous plants, including the cabbage, cauliflower, radish, turnip and rutabaga. The young plants suffer most from their attacks, entire fields being badly injured. This is particularly true of young cabbage plants. Radishes and turnips not killed when young continue to afford food for the maggots.

Control.—The control of such a pest is extremely difficult and relief measures are usually employed as preventatives. Among the most effective of these are the placing of sand, soaked in kerosene, around the bases of each plant as soon as transplanted or well up in the field.

This is to prevent egg-laying by the female. A weak solution of carbolic acid emulsion sprayed repeatedly over the plants will keep the flies away. Fertilizers such as kainit, nitrate of soda and superphosphate applied at the rate of from 1,000 to 1,500 pounds of kainit, 100 pounds of nitrate of soda, and 200 pounds of superphosphate per acre are recommended. Gas lime applied around each plant has afforded some protection.*

Carbon bisulfid, though an expensive remedy, is effectual. A special tarred card placed around the base of cabbage and cauliflower plants prevents the flies depositing their eggs upon the stem.

Plowing and thorough cultivation are recommended as giving excellent results in the control of this pest. A badly infested field should be thoroughly plowed and cultivated as early as possible to destroy the pupæ.

Natural Enemies.—A small parasitic insect has been reared from the puparia. Twelve were obtained from a single one. This has not been determined and is probably responsible for the maggots not doing more serious damage in this State.

TACHINIDÆ (Family).

THE TACHINA FLIES.

This is one of the most beneficial families of insects, because of the parasitic habits of the larvæ upon destructive caterpillars, grasshoppers, bugs, beetles, sawflies, etc.

The adults are little larger than house flies, being striped and grayish in color with hairy bodies. They are only active on warm days. The eggs are usually white and stuck to the living larvæ (Fig. 142) upon which the coming maggot is to feed. Upon hatching the larvæ bore through the skin of the host, nourishing themselves throughout their development upon the internal tissues, avoiding the destruction of the vital organs until ready to pupate. When the host is destroyed they leave the old carcass and form hard brown puparia near the surface of the ground. The adults issue from these in a very short time. Breeding is rapid, there being several generations each year.

THE DIABROTICA PARASITE.

Celatoria diabroticæ Shim.

(*Celatoria crawii* Coq.)

(Fig. 256.)

General Appearance.—Grayish black flies with white face, black antennæ and legs, grayish black thorax and abdomen. The adult males have a peculiar large flattened process on the underside of the second abdominal segment. The length is about one eighth of an inch. The larvæ are white and the puparia dark brown.

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*Circular No. 63, Bur. Ent. U. S. Dept. Agrcl. p. 3.

Life History.—The maggots of the fly work within the adult beetles, parasitizing in many instances at least one third of them. The larvæ appear about May and continue as late as October; the first brood pupating for about the first two weeks in June. The adults appear most numerous in July and August—a few no doubt surviving the winter. The period of hibernation is usually spent in the pupal stage.

Distribution.—Throughout the southern part of the State, being first reported at Los Angeles by Mr. Alexander Craw.

Hosts.—Works upon the adults of the western cucumber beetle, *Diabrotica soror.*

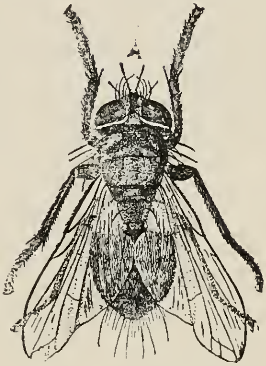

Fig. 256.—The diabrotica parasite, *Celatoria diabroticæ* Shim. (After Coquillett.)

THE TUSSOCK MOTH TACHINID.

Tachina mella Walk.

(Fig. 257.)

General Appearance.—The adult flies appear dark gray in color. The eyes are brown; face white; thorax black with dull gray markings; halteres white; abdomen black with regular gray spots on the sides of the dorsum; legs and antennæ black. The females are three eighths of an inch long and the males considerably smaller, as shown in Figure 257.

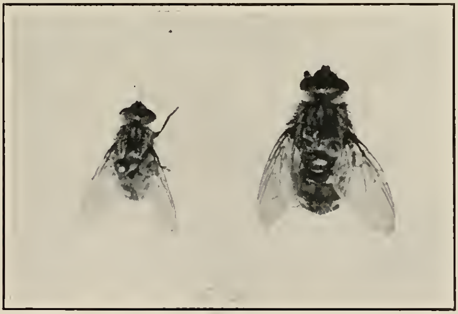

Fig. 257.—The tussock moth tachinid (*Tachina mella* Walk.). Male at left and female at right. Slightly enlarged. (Original.)

Distribution.—Throughout the entire State. Quite a common species.

Hosts.—This fly preys upon the tussock moth (*Hemerocampa vetusta* Boisd.), the western apple-tree tent caterpillar (*Malacosoma disstria* Hubn.) and other species of *Malacosoma.*

THE PLAGUE GRASSHOPPER PARASITE.

Masicera pachytili Skuse.

(Fig. 258.)

General Appearance.—The adult flies are somewhat smaller than the ordinary house flies and dark gray in color with white face and light halteres.

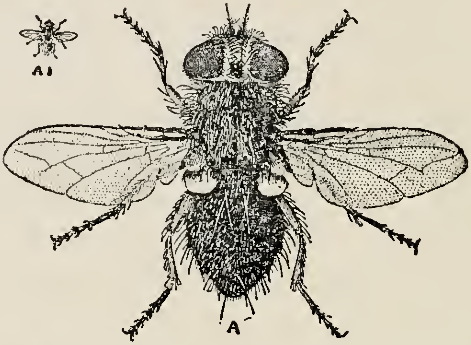

Fig. 258.—The plague grasshopper parasite (*Masicera pachytili* Skuse). A¹, natural size; A, enlarged.

Distribution.—This fly was introduced into California by Geo. Compere from Australia, where it does great execution on the plague locust or grasshopper. To what extent it has become established is not known.

Hosts.—Works upon grasshoppers.

Peleteria robusta Wied.

(Fig. 259.)

General Appearance.—The adults are about one half inch long. The face is white; antennæ brown and black; eyes brown; thorax metallic black and dull grayish along the sides; the abdomen brick-red or yellowish with black dorsal and median longitudinal stripe.

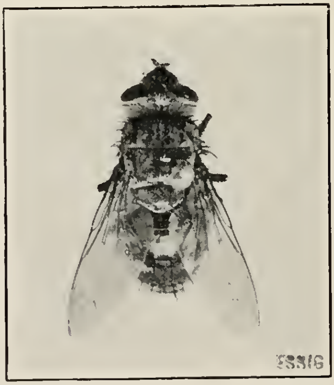

Fig. 259.—*Peleteria robusta* Wied. Enlarged. (Original.)

Distribution.—Common throughout the entire State, having been reported from Lake, Santa Cruz, Calaveras, Los Angeles and San Bernardino counties.

Hosts.—This species works upon the larvæ and pupæ of the tussock moth (*Hemerocampa vetusta* Boisd.) and other moths.

Paradejeania rutilioides Jaen.

(Fig. 260.)

General Appearance.—The adult of this species is large, measuring nearly three fourths of an inch in length. The abdomen is especially large and covered with long black hairs. The face is black with a silvery luster; eyes dark brown; antennæ black; thorax black with yellow margin and scutellum; basal half of the abdomen yellow with a longitudinal median line and the apical half black; wings dusky throughout with yellow base; legs black.

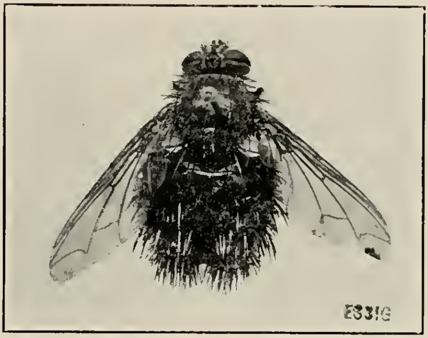

FIG. 260.—*Paradejeania rutilioides* Jaen.
Enlarged. (Original.)

Distribution.—Throughout the central and southern parts of the State.

Hosts.—Caterpillars.

HYMENOPTERA (Order).

MEMBRANOUS-WINGED INSECTS.

BEES, WASPS, GALL-FLIES, SAW-FLIES AND ANTS.

This is without doubt the most important order of insects known, comprising not only the most beneficial insects like the honey bees and parasitic insects, but some very injurious forms like the sawflies and Argentine ant. The transformations are complete, the larva being maggot- or grub-like and the pupa quietescent. The adults usually have four well developed membraneous wings and are powerful fliers, but a great many members have no wings at all. The mouth-parts are for biting or modified for lapping. There is a very extraordinary phenomenon of sex abortion and the development of a sting in the females of certain families, while the phenomena of virgin-birth and the formation of galls are no less wonderful.

Due to the great specialization of the members, this order is extremely complicated and no attempt at classification will be undertaken here, and only a very few of the families will even be represented.

TRUE PARASITES.

Of the beneficial insects, by far the most effective are the true parasites belonging to the superfamilies *Ichneumonoidea*, *Cynipoidea*, *Chalcidoidea* and *Proctotrypoidea*. Not all of the members of these superfamilies are beneficial. Some prey upon seeds as the seed chalcis and many others upon beneficial predaceous and parasitic insects. And not all the true parasites belong to these four superfamilies, for as we have seen many dipterous insects are very efficient parasites. In all the superfamilies, except the *Ichneumonoidea*, many of which are quite large, the members are usually exceedingly small; a hand lens or microscope being necessary for the study of them.

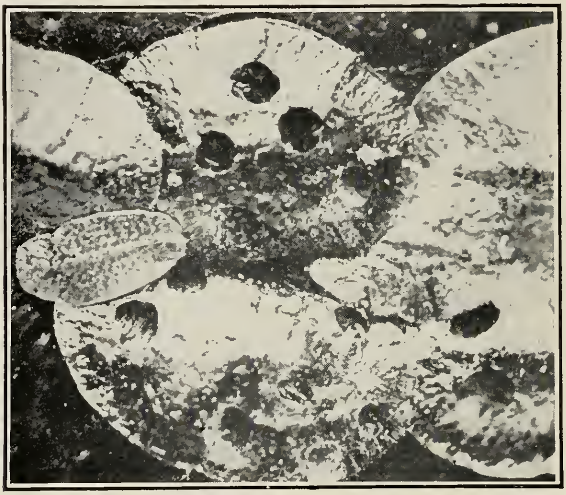

FIG. 261.—Soft brown scale (*Coccus hesperidum* (Linn.), showing exit holes of true parasites. (After Quayle. Courtesy Cal. Exp. Sta.)

The females usually deposit their eggs within, beneath or attached to the outer surface of the host or within the egg, by means of an ovipositor specialized for such purposes. Upon hatching, the young legless larvæ begin feeding upon the body or juices of the host or egg;

the vital tissues of the former being reserved until the larvæ are nearly ready to pupate.

The entire larval period is passed within or upon the host. The pupal stage may be passed within the host or attached or not attached to it.

There are great variations in the time of development, there being but one generation a year in some and many in others. The adults are usually four-winged insects with quick power of flight and great activity. Many of the smaller species have the ability to jump not unlike fleas.

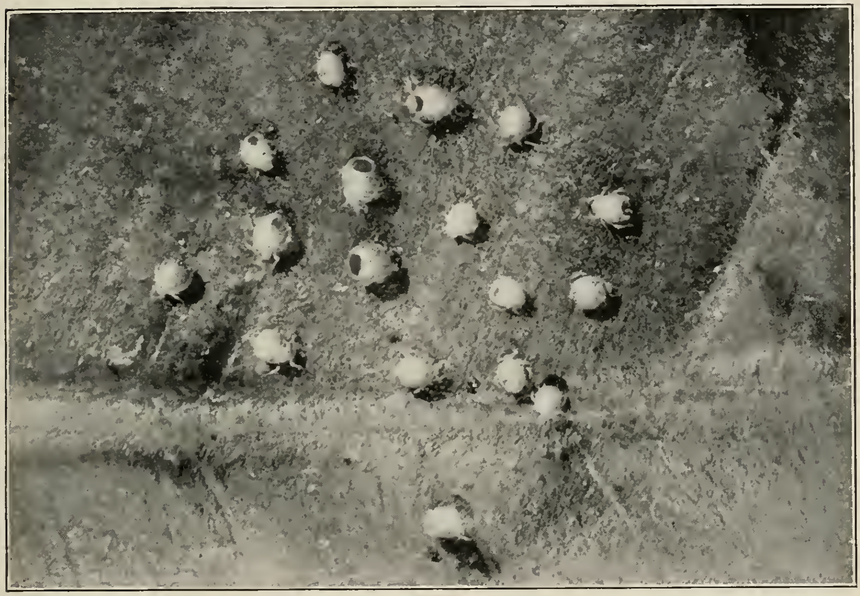

FIG. 262.—Mummied bodies of the citrus aphid (*Toxoptera aurantiæ* Koch), showing exit holes of the internal parasites. (Essig, P. C. Jr. Ent.)

The work of all true parasites is rather spasmodic because of the very nature of their existence. Naturally with the decrease in the numbers of the hosts, the parasites die from lack of food and may be so reduced in numbers that they are not able to check the rapidly increasing numbers of the hosts and a plague of grasshoppers, army worms or scale insects may result.

Unfavorable weather conditions and the work of secondary parasites are also often responsible for the poor showing of these beneficial friends.

PARASITE OF THE COMMON MELON APHIS.

Aphidius testaceipes (Cresson) (Family Braconidæ).*

(*Lysiphlebus testaceipes* Cresson.)

(Fig. 263.)

General Appearance.—The adults are exceedingly small to develop within the bodies of the plant lice, being but seven hundredths of an inch long. The bodies are very slender, dull or shiny black, with legs, antennæ and base of abdomens pale amber. The wings are hyaline and iridescent with pale amber stigma. The adult females of these true par-

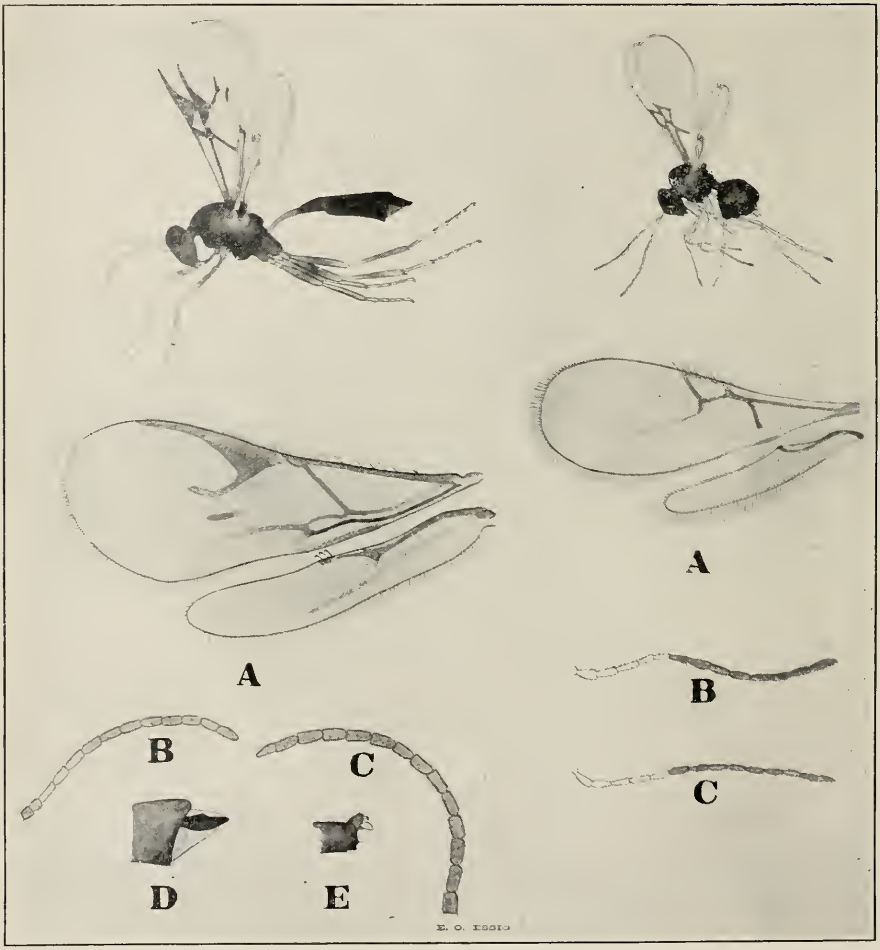

FIG. 263.—*Aphidius testaceipes* (Cr.) on left; *Charips xanthopsis* (Ashm.) on right. A, wings; B and C, antennæ; D, abdomen of female; E, abdomen of male. (Essig, P. C. Jr. Ent.)

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*The writer is indebted to Harry S. Smith for information concerning these hymenopterous parasites, and for aid in placing them in the proper families.

asites deposit their eggs within the living tissues, inside the bodies of the plant lice, by means of a long, sharp-pointed ovipositor, which pierces the body walls of the lice. The outside wound heals over in a short time, leaving the egg tightly sealed within the body ready to hatch. As soon as the egg is hatched the small, legless larva begins to feed upon the tissues of the aphid and its development means the extinction of a louse. When it is fully developed and ready to leave the "mummied" louse, it cuts a circular hole in the top of the body and escapes an adult winged insect, ready to produce more eggs and thereby to destroy more lice. The life-cycle varies according to the time of year. In the colder months it covers from about ninety to one hundred days, while during the summer months it covers from eight to fifteen days.

The so-called "mummied" plant lice (Fig. 262) are easily recognized before the adult parasite escapes by the inflated and discolored bodies which appear among the healthy individuals. These bodies are usually of a lighter color and finally become entirely bleached. The circular hole cut by the escaped parasites is always a sure sign of the presence of these beneficial insects. The "mummies" are fastened to the leaf, as soon as the louse is dead, by the larva of the parasite, which cuts a slit in the lower side of the body and fastens the sides to the leaf or twig by excreting a mucilaginous or weblike substance for this purpose.

Distribution.—Very common throughout the entire State.

Hosts.—This species preys upon many of the common plant lice. So far it has been bred from the orange aphid (*Toxoptera aurantiæ* Koch.), the cotton aphis (*Aphis gossypii* Glover) and the green apple aphis (*Aphis pomi* De Geer).

THE CODLING MOTH PARASITE.

Calliephialtes messor Grav. (Family Ichneumonidæ).

(Fig. 264.)

General Appearance.—The minute eggs deposited in the cocoons of the codling moth are shiny white, almost transparent in color and long and narrow, with one end slightly enlarged. The adults are very active, four-winged parasites, averaging three eighths of an inch in length, exclusive of the ovipositor which is slightly longer than the body in the females. The males are slightly smaller. The general color is black with reddish-yellow legs.

Life History.—The female, with her long ovipositor, inserts an egg into the cocoon of the codling moth. In a few days this egg hatches into a small, legless grub, which begins to feed upon the larva. The subsequent development is very rapid and at the end of from nine to sixteen days the larva spins a cocoon within the old shell and after another like period emerges as an adult. The males emerge first and await the females, when mating occurs and the life cycle repeated; the females continually searching for cocoons into which to deposit their supply of eggs.

Distribution.—This parasite was discovered in southern Europe by

George Compere, who collected large numbers and sent them to the State Insectary some eight years ago. During this period the Insectary has been breeding and sending it out to all parts of the State where the codling moth is a factor in fruit growing. It was especially thoroughly distributed in the central and southern parts.

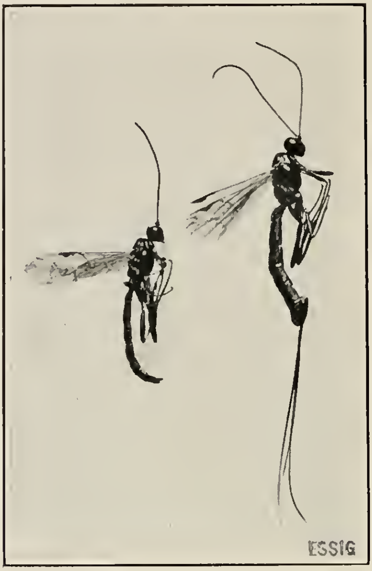

FIG. 264.—The codling moth parasite (*Calliephialtes messor* Grav.). Male at left and female at right. Slightly enlarged. (Original.)

Hosts.—The larvæ enclosed in the cocoons are the only stages of the codling moth attacked. These are carefully searched out by the females which have a wonderful instinct to locate them as well as to ascertain whether they have already been parasitized or not.

THE CITRUS APHID PARASITE.

Charips xanthopsis (Ashm.) (Family Figitidæ).

(*Allotria xanthopsis* Ashm.)

(Fig. 263.)

General Appearance.—This small parasite belongs to a family closely allied to the gall makers. The adults are exceedingly small, being less than one tenth of an inch long. The general color of the body is black, with legs, bases of the antennæ and ovipositor light amber.

Life History.—The life history is practically the same as that of *Aphidius testaceipes* Cresson.

Distribution.—Common in the southern part of the State, especially in Ventura County.

Host.—This parasite preys effectually upon the citrus aphid (*Toxoptera aurantiæ*).

THE CLOVER SEED CHALCIS.

Bruchophagus funebris How. (Family Eurytomidæ).

(Fig. 265.)

General Appearance.—From the fact that this insect works within a clover seed it must be very small in size. The adults are black with dark brown eyes and light brown feet. The eggs are slightly elongated with a long, slender pedicle and polished white. The larvæ are white and just large enough to fill the empty shells of the clover seeds. The pupæ are first white, afterwards changing to brown. The entire life cycle from the egg until the adult emerges is spent within the seeds, the contents of which are completely devoured by the larvæ. However, occasionally a larva may work upon several different seeds.

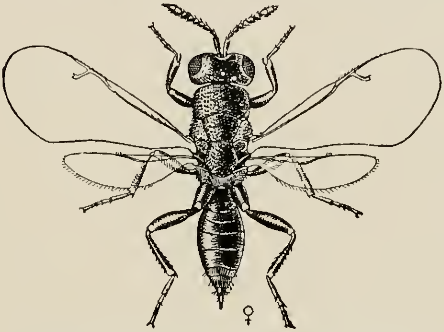

Fig. 265.—The clover-seed chalcis, *Bruchophagus funebris* How. Adult female greatly enlarged. (After Webster.)

Life History.—The winter is spent in the seeds either as larvæ or pupæ. About blooming season the adults emerge and begin egg-laying. The eggs are inserted within the forming seeds by the ovipositor. There are probably several generations each year.

Distribution.—Although this insect is reported as existing in the State, it is difficult to give the exact areas infested. It is liable to be met with in any section where clover and alfalfa seed are extensively raised. Due to the small size the pest may exist for some time in a locality without being discovered. It is now known to occur in the central and southern parts.

Food Plants.—So far the chalcis has been reported as working upon the seeds of red and crimson clover and alfalfa. The seeds are either entirely eaten out or rendered worthless and in both cases are usually blown out with the chaff, so that the amount of damage will pass for years unobserved.

Control.—So far this pest has received little or no attention[1]—there being no requests for help, but in spite of this, great damage is being done. This is unfortunate, as control measures are difficult and poorly worked out. Pasturing the fields or destroying all clover and alfalfa heads in the winter, as well as the destruction of the straw after threshing, are check measures well worth adopting.

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[1] An expert of the Bureau of Entomology, U. S. Dept. of Agrcl., is now working upon this insect in California.

*THE BLASTOPHAGA.

Blastophaga grossorum Grav. (Family Agaonidæ).

General Appearance.—The adults are exceedingly small, being about one sixteenth of an inch long, the male being brown or amber and the female shiny black in color. The female is winged, has large compound eyes and three ocelli; ten-articled antennæ; well developed gnawing mouth-parts and sharp ovipositor, which, when fully extended, is exceedingly long. The male is always wingless, has small compound eyes and no ocelli. The eggs are white, elliptical, with a short petiole and 0.092 mm. long. The larvæ are legless and white with brown mandibles. They are exceedingly small.

Life History.—This very important beneficial insect is propagated only in certain nonedible figs, known as caprifigs. In these the females lay their eggs in the ovaries of the flowers by pushing the ovipositor down through the hollow style. The ovaries inhabited by the larvæ are called galls, as in them the insects feed and develop. The males issue first and crawl about over the galls, gnawing holes in those containing the females with their powerful jaws, into which the abdominal projection is inserted and the females fertilized. Next day the mature and fertilized females enlarge the openings and crawl out. Leaving the fig by the eye they enter the next crop of figs on the same capri tree, which are more in a receptive condition, unless the caprifigs containing the mature insects are hung in the Smyrna trees, when they enter the Smyrna figs. They wander about in a vain effort to get rid of their eggs and in doing so distribute the pollen adhering to their bodies to the female flowers and then crawl out of the fig.

The capri tree, the crop of which is the only one in which the insect can lay its eggs, on account of the shape of the flowers, produce three distinct crops, called, respectively, *mamme*, *profichi*, and *mammoni*. The first, the over-wintering crop, contains no pollen and can not, therefore, be used to fertilize the Smyrna figs. The *profichi* contain an abundance of pollen which is available at the time the insect reaches maturity, and as at this time (June) the young Smyrna figs are in a receptive condition, it is the one used to pollinate the Smyrna crop. As the Smyrna fig will not develop to maturity without pollen and as the flowers are inside the fig, some method must be used to carry the pollen to them. For this purpose the *Blastophaga* is utilized, and the act of placing the caprifigs on the female trees is called caprification. The whole Smyrna fig industry is absolutely dependent upon this process. In order to provide a supply of the *Blastophaga*, caprifigs are planted convenient to the commercial fig orchards. These caprifig trees usually hold their fruit during the winter. Occasionally, however, severe frosts destroy the over-wintering caprifigs and the *Blastophaga* perishes with them. To avoid such losses the *mamme* crop of caprifigs, in which the

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*The writer is indebted to Mr. G. P. Rixford, Bur. Plant Industry, U. S. Dept. Agrcl., for this information regarding *Blastophaga grossorum*.

Blastophaga hibernates in the larval stage, may be picked in December and packed in layers in boxes of clean, damp sand and kept in a place where the temperature is about 55 or 60 deg. Fahr. In the spring these figs are taken to the caprifigs and the *Blastophaga* allowed to issue when the young caprifigs are ready for fertilization, which is about April. At this time the *profichi* crop is receptive. This crop is exceedingly rich in pollen which sticks to the bodies of the females and is carried thus into the Smyrna figs.

Distribution.—This insect is now distributed throughout the commercial fig growing sections of the State, which are practically confined to the Sacramento and San Joaquin valleys.

PARASITE OF THE BROWN APRICOT SCALE.

Comys fusca Howard (Family Encyrtidæ).

(Fig. 266.)

General Appearance.—The adults of this parasite are about one eighth of an inch long and rich brown throughout in color. The wings are clouded with brownish markings, the bases remaining clear and when folded over the back, form a silverlike spot which is very noticeable when the insects are walking. The veins are black. The tips of the legs are yellowish with dark claws.

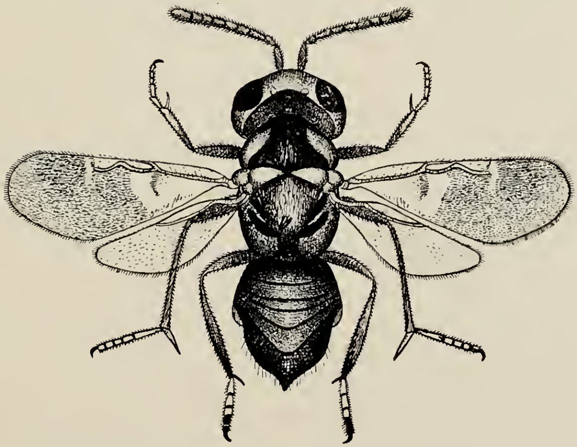

Fig. 266.—*Comys fusca* Howard, the parasite of the brown apricot scale. (Original. Drawing by Birdnekoff).

Distribution.—One of the most common parasites occurring in all parts of the State.

Hosts.—Of all the internal parasites of scale insects this is one of the most efficient and is often quite a controlling factor in keeping down the brown apricot scale (*Lecanium corni*). The writer has also bred this parasite from the frosted scale (*Eulecanium pruinosum*) and a native scale (*Lecanium* sp.) in Ventura County.

PARASITE OF THE SOFT BROWN SCALE.

Encyrtus flavus Howard (Family Encyrtidæ).

(Fig. 267.)

General Appearance.—A small parasite scarcely one sixteenth of an inch long. The general color of the female is ochre; compound eyes brown; ocelli red; antennæ yellow with tips black; the tips of the feet black. The basal third of the fore wings are clear with the remainder clouded with brown; the hind wings are clear. The males are considerably smaller than the females, and shiny metallic green in color with legs and antennæ very light; wings clear with brown veins.

Distribution.—Quite common throughout the State, but especially abundant in the southern part.

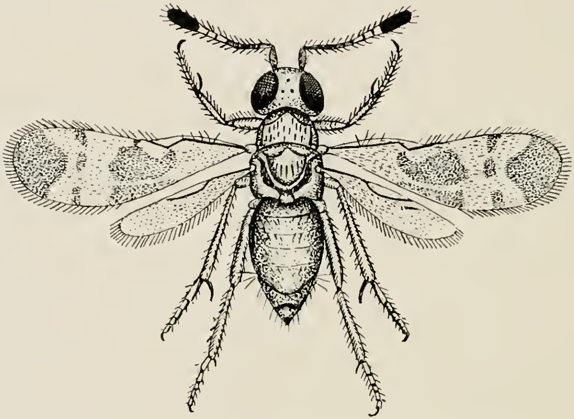

Fig. 267.—*Encyrtus flavus* Howard, parasitic on the soft brown scale. (Original. Drawing by Birdnekoff.)

Hosts.—Reared from the soft-brown scale (*Coccus hesperidum*), which is often very effectually checked by its attacks.

THE SCUTELLISTA.

Scutellista cyanea Motsch. (Family Encyrtidæ).

(Fig. 268.)

General Appearance.—The adult is a small four-winged parasite, less than one eighth of an inch long, robust and metallic steel-blue to nearly black in color.

Life History.—The small oblong white eggs are placed under the shell of the black scale. They are somewhat larger than the eggs of the scale and hatch in from five to six days into crescent-shaped white legless larvæ, which feed upon the eggs of the black scale for fifteen to twenty days, when they pupate and after another like period emerge as adults from the shells of the scale through circular holes cut for this purpose. The adult lives a little over a week.

Distribution.—Throughout the entire State.

Hosts.—Introduced especially to prey upon black scale (*Saissetia* *oleæ*). It does very effective work on this pest in certain sections, but its work is so uncertain and sporadic as to make it extremely unreliable.

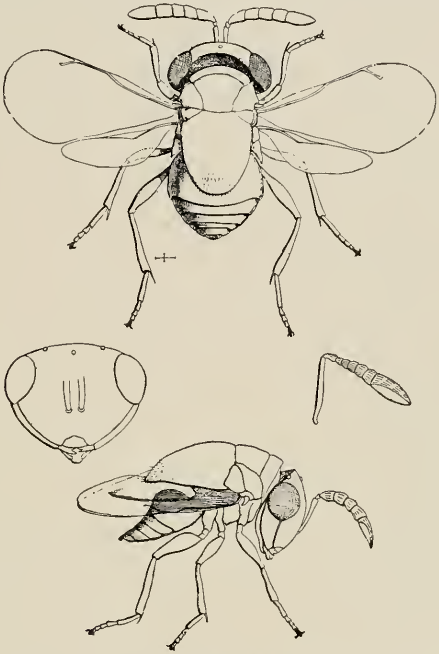

FIG. 268.—*Scutellista cyanea* Motsch. (After Howard.)

However, if judicially distributed, it is a great help in checking this pest. It also works on the hemispherical scale (*Saissetia hemisphærica*).

THE CITRUS MEALY BUG PARASITE.

Chrysoplatycerus splendens Howard (Family Encyrtidæ).

(Fig. 269.)

General Appearance.—This very small internal parasite is but 2 mm. long. It is easily distinguished by its iridescent black color, shiny scutellum and large and geniculate antennæ. The scutellum has a very noticeable tuft of bristles at the apex. The pointed abdomen also has a tuft of bristles upon each side. The apical two thirds of the fore wings are very black while the basal third and the hind wings are lighter.

Life History.—The female is rather deliberate in her actions and may remain in a very small area for an hour or so, all the time busy examining the host. In doing this she holds her antennæ as is shown in the lateral view in Fig. 269, and does all of the feeling with the tips. These she moves very rapidly and when a suitable host has been found she turns around and punctures it with the ovipositor and deposits the egg. From observations it is very probable that she deposits but one egg in an individual. When touched or disturbed she jumps and may even fly away. She rests with the body close to the supporting fruit or leaf, with the legs spread out at the sides and the antennæ flattened out in front, not unlike two long front legs. It was possible to obtain a large number of these internal parasites from small breeding cages filled with adult mealy bugs and their egg masses, but the good they do is very difficult to estimate. Great numbers were kept confined for a year, but the number of mealy bugs increased enormously while the parasites almost entirely disappeared. In mounting hundreds of adult mealy bugs I have been unable to procure one that contained the larval form of the parasites, but the empty skins from which they have issued are plyentiful on the trees in the orchards.

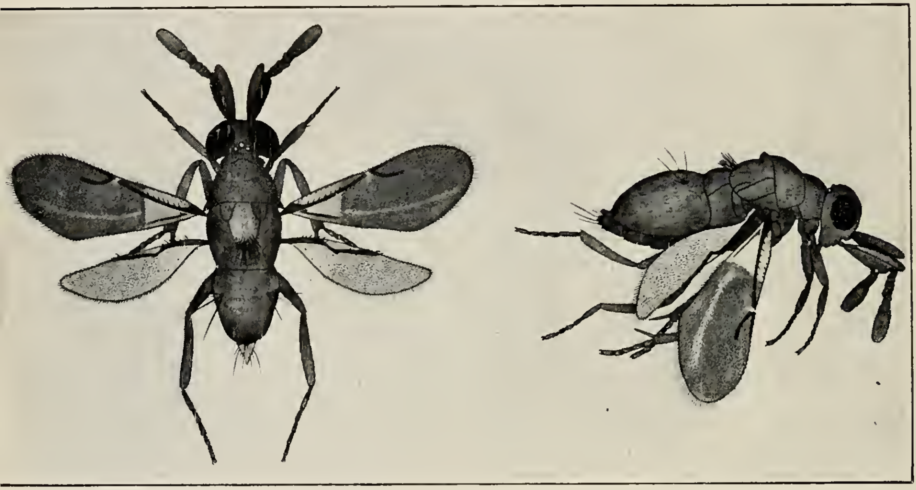

FIG. 269.—Dorsal and lateral aspects of the mealy bug parasite, *Chrysoplatycerus splendens* How. (Essig, P. C. Jr. Ent.)

Distribution.—In the southern part of the State and reported only in Ventura County.

Hosts.—Half-grown and adult mealy bugs (*Pseudococcus citri.*).

BLACK SCALE PARASITE.

**Tomocera californica* Howard (Family Encyrtidæ).

(Fig. 270.)

General Appearance.—The females are slightly more than one sixteenth of an inch long. The general color is metallic bluish-black, with head, base of antennæ and the undersides of the legs rich reddish brown; thorax metallic black; abdomen metallic bluish-black with brown spot near the base; upper portions of legs and tips of antennæ black and the latter distinctly hairy. Wings dark with short fringe. The males are metallic black; bases of antennæ brown and tips black; all parts of legs except black hind tibia are amber; wings perfectly clear.

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*The correct name of this parasite is *Dilophogaster californica* How.

Distribution.—Abundant in most of the southern citrus growing sections of the State.

Hosts.—The larvæ work upon the eggs and young of the black scale (*Saissetia oleæ*). This year R. S. Vaile, Horticultural Commissioner of Ventura County, reports that this parasite has wrought great execution upon the black scale in certain citrus orchards near Ventura.

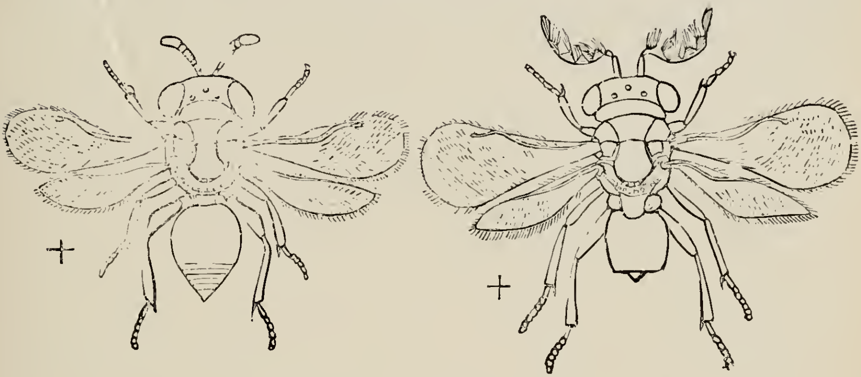

FIG. 270—The male and female of the black scale parasite, *Tomocera californica* Howard. (U. S. Dept. Agrcl.)

Aphycus flavus Howard (Family Encyrtidæ).

(Fig. 271.)

General Appearance.—This is a small, yellow four-winged insect as shown in Fig. 271.

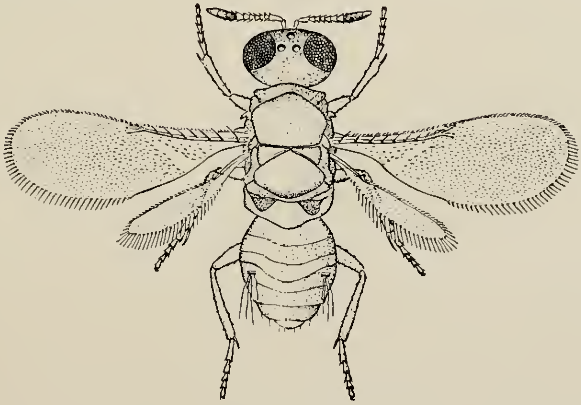

FIG. 271.—*Aphycus flavus* How. (After Howard. Courtesy Cal. Exp. Sta.)

Distribution.—Especially abundant in the southern part of the State, but also found further north.

Hosts.—This species is a very important enemy of the soft brown scale (*Coccus hesperidum* Linn.) and when abundant is a very efficient check to this pest.

Aphycus immaculatus Howard (Family Encyrtidæ).

(Fig. 272.)

General Appearance.—A small dark parasite, slightly over .05 mm. in length. The general color is dark yellowish-brown with light yellow head, dusky legs and antennæ and hyaline wings.

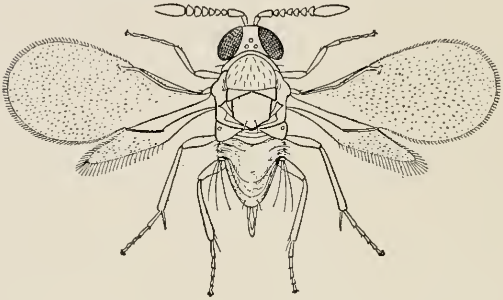

Fig. 272.—*Aphycus immaculatus* How. (After Howard. Courtesy Cal. Exp. Sta.)

Distribution.—So far as known this species occurs only in the southern part of the State.

Hosts.—Parasitic upon red scale (*Chrysomphalus aurantii*).

THE KATYDID EGG PARASITE.

Eupelmus mirabilis (Walsh) (Encyrtidæ).

General Appearance.—The adult parasites are a little more than one eighth of an inch long and of a metallic green color. The wings are dusky. The insect has a peculiar way of elevating the abdomen over the thorax.

Life History.—The eggs are deposited within the eggs of the katydid by the female. The entire contents of the eggs are devoured by the larvæ and the transformations to adults occur within the eggs, the adults issuing through circular holes in the sides. (Fig. 21.)

Distribution.—Common throughout the entire State.

Hosts.—This parasite works upon the eggs of various katydids.

PARASITE OF WHITE FLIES.

Gyrolasia flavimedia Howard (Family Eulophidæ).

(Fig. 273.)

General Appearance.—An extremely minute parasite about one twenty-fifth of an inch long. The general color is rich metallic black, the second and last abdominal segments being bright orange with bases of antennæ, the legs and the under side of the abdomen yellow. The fore wings are clear with a distinct dark spot near the middle of the front margin. The veins are black.

Distribution.—Reported only from the southern part of the State in Los Angeles County.

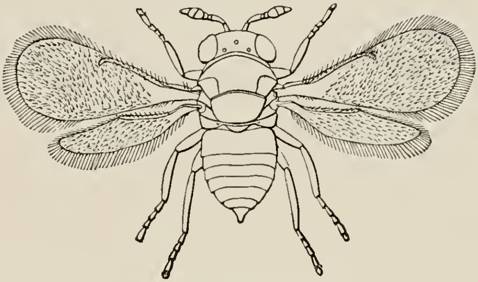

FIG. 273.—*Gyrolasia flavimedia* Howard. (U. S. Dept. Agrcl.)

Hosts.—This insect is parasitic upon the species of white flies (*Aleyrodes* sps.) infesting iris and fuchsia.

THE PURPLE SCALE PARASITE.

Aspidiotiphagus citrinus Craw (Family Eulophidæ).

(Figs. 274, 275.)

General Appearance.—An exceedingly small insect, almost microscopic in size, light and brownish yellow in color with wings, antennæ and legs pale.

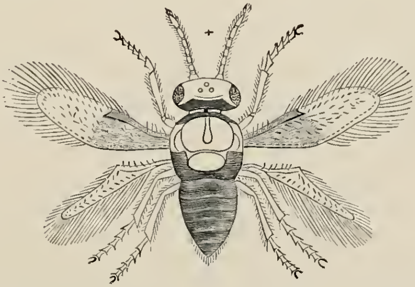

FIG. 274.—The purple scale parasite, *Aspidiotiphagus citrinus* Craw. (After Howard.)

Distribution.—Generally distributed throughout the purple scale-infested citrus districts in the southern part of the State, but often limited or totally absent in certain localities. Most abundant in San Diego County.

Hosts.—Works uncertainly but often very effectually on purple scale (*Lepidosaphes beckii*) in small localities, but of little consequence in controlling this pest. It also works on yellow scale (*Chrysomphalus citrinus*), red scale (*Chrysomphalus aurantii*), and pernicious scale (*Aspidiotus perniciosus*).

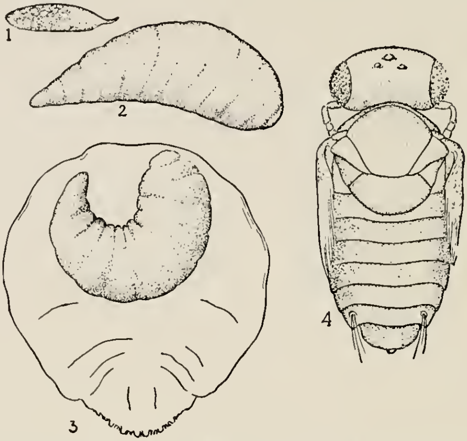

FIG. 275.—*Aspidiotiphagus citrinus* Craw. 1, egg; 2, larva; 3, larva within the body of a yellow scale; 4, pupa. Greatly enlarged. (After Quayle. Courtesy Cal. Exp. Sta.)

Prospaltella aurantii Howard (Family Eulophidæ).

(*Prospalta aurantii* Howard.)

(*Coccophagus aurantii* Howard.)

(Fig. 276.)

General Appearance.—A very small brownish-yellow parasite with black compound eyes; red ocelli; legs reddish and veins of wings dusky.

Distribution.—First discovered by D. W. Coquillett at San Gabriel, California, in 1887 and is more or less generally distributed in the southern part of the State.

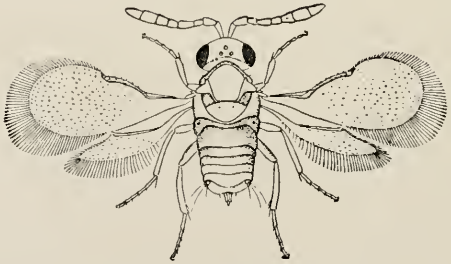

FIG. 276.—*Prospaltella aurantii* Howard. (After Howard. Courtesy Cal. Exp. Sta.)

Hosts.—Parasitic upon yellow scale (*Chrysomphalus citrinus*) in California but has also been bred from purple scale (*Lepidosaphes beckii*), pine scale (*Aspidiotus pini*), *Aspidiotus ancylus*, walnut scale (*Aspidiotus juglans-regiæ*), *Eulecanium persicæ* and *Chionaspis* sps.

Signiphora occidentalis Howard (Family Eulophidæ).

(Fig. 277.)

General Appearance.—One of the smallest parasites, being scarcely over half a millimeter in length and rather robust. The general color is dark brown or nearly black; eyes dark red, mesonotum yellow; legs and antennæ amber, wings dusky with long fringe; forewings with indefinite dark blotch near the middle.

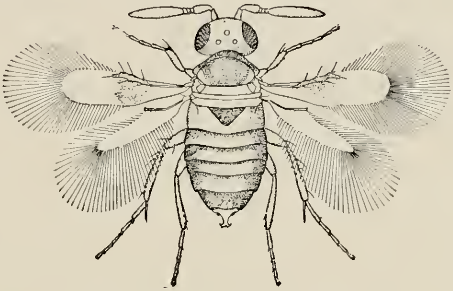

FIG. 277.—*Signiphora occidentalis* Howard. (After Howard. Courtesy Cal. Exp. Sta.)

Distribution.—In the southern part of the State.

Hosts.—Parasitic on yellow scale (*Chrysomphalus citrinus*).

Aphelinus mytilaspidis LeBaron (Family Eulophidæ).

(Fig. 278.)

General Appearance.—The adult parasites are exceedingly small, being about one thirty-second of an inch long. The color is bright lemon yellow; base of antennæ dusky; eyes dark; ocelli red; mandibles brown; legs and wing veins bright yellow.

Distribution.—Quite common throughout the State.

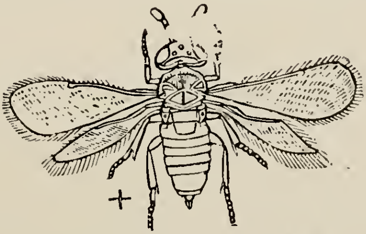

FIG. 278.—*Aphelinus mytilaspidis* Le Baron. (After Howard.)

Hosts.—This parasite preys upon a number of scales, among which are the oyster shell scale (*Lepidosaphes ulmi*), pine scale (*Chionaspis pinifoliæ*), San José scale (*Aspidiotus perniciosus*) and *Diaspis carueli*.

THE GOLDEN CHALCID.

Aphelinus diaspidis Howard (Family Eulophidæ).

(Fig. 279.)

General Appearance.—The adults are exceedingly small and delicate, bright yellow insects.

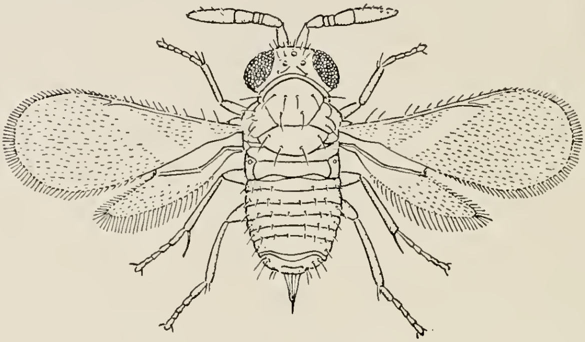

FIG. 279.—*Aphelinus diaspidis* Howard. (After Howard. Courtesy Cal. Exp. Sta.)

Distribution.—Common throughout the southern part of the State, though it probably occurs in many central and northern sections.

Hosts.—Parasitic upon red scale (*Chrysomphalus aurantii*) and rose scale (*Aulacaspis rosæ*).

Coccophagus lunulatus Howard (Family Eulophidæ).

(Fig. 280.)

General Appearance.—Minute parasites less than 1 mm. long. The general color is black; apical two thirds of scutellum orange with black

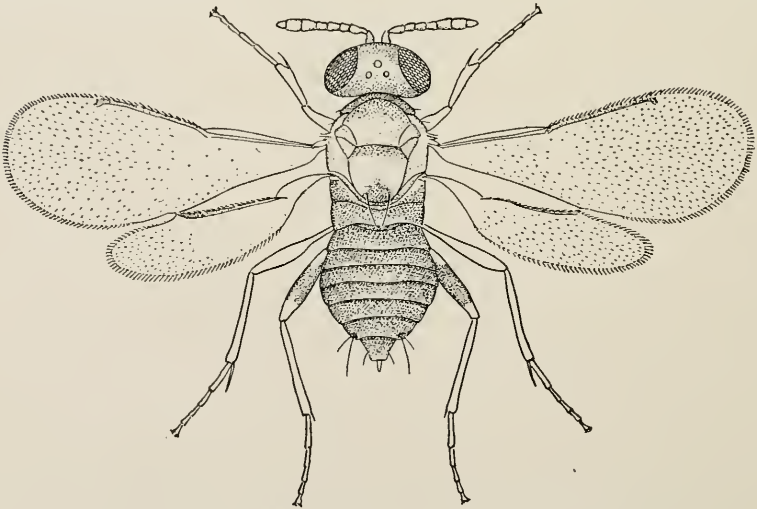

FIG. 280.—*Coccophagus lunulatus* Howard. (After Howard. Courtesy Cal. Exp. Sta.)

tips; antennæ dark; legs yellow with hind femora dusky in middle; wings hyaline with dark brown veins.

Distribution.—Occurs in the southern part of the State.

Hosts.—Parasitic upon red scale (*Chrysomphalus aurantii*).

Coccophagus lecanii (Fitch.) (Family Eulophidæ).

(Fig. 281.)

General Appearance.—The adults are scarcely one eighth of an inch long, dark bluish-black in color with a very noticeable and characteristic yellow scutellum. The antennæ and the legs, excepting the dark femora, are amber.

Distribution.—Exceedingly common throughout the entire southern and central parts of the State.

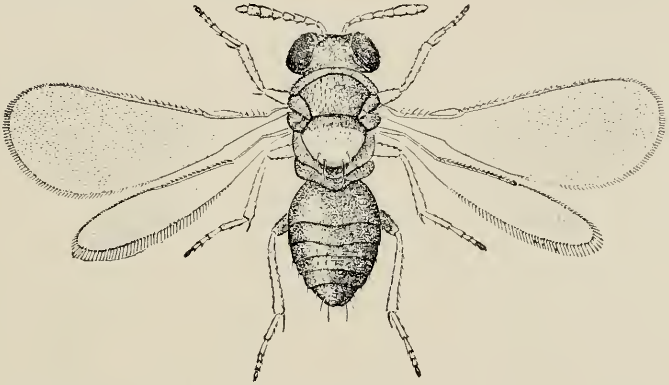

Fig. 281.—*Coccophagus lecanii* (Fitch). (After Howard. Courtesy Cal. Exp. Sta.)

Hosts.—A very effective parasite on soft-brown scale (*Coccus hesperidum*), European fruit scale (*Lecanium corni*) and frosted scale (*Eulecanium pruinosum*). In fact it may be reared from almost any of the members of the above genera.

THE RASPBERRY HORN-TAIL.

Hartigia cressoni (Family Siricidæ).

(*Hartigia abdominalis.*)

(Fig. 282.)

General Appearance.—The adults are slender wasp-like insects, little more than one half inch long and very active fliers. The females are yellow with dark markings, while in the males black predominates with very little yellow. The eggs are pearly white and oblong with a curved point at one end. The full-grown larvæ are white with dark head and tip and are nearly one inch long. They are almost the shape of a letter "S" and have a very noticeable point at the tail end. The pupæ vary from the color and shape of the larvæ to those of the adults.

Life History.—The winter is passed within the canes of the host plants in the larval and pupal stages. The adults emerge in April and after mating the females begin to insert their eggs into the tender tips of the young shoots. The eggs hatch in a short time into larvæ which work up the shoots until the latter are killed, when they turn and go down the middle pith of the stems and transform in the late fall and winter into pupæ. There is but one brood each year.

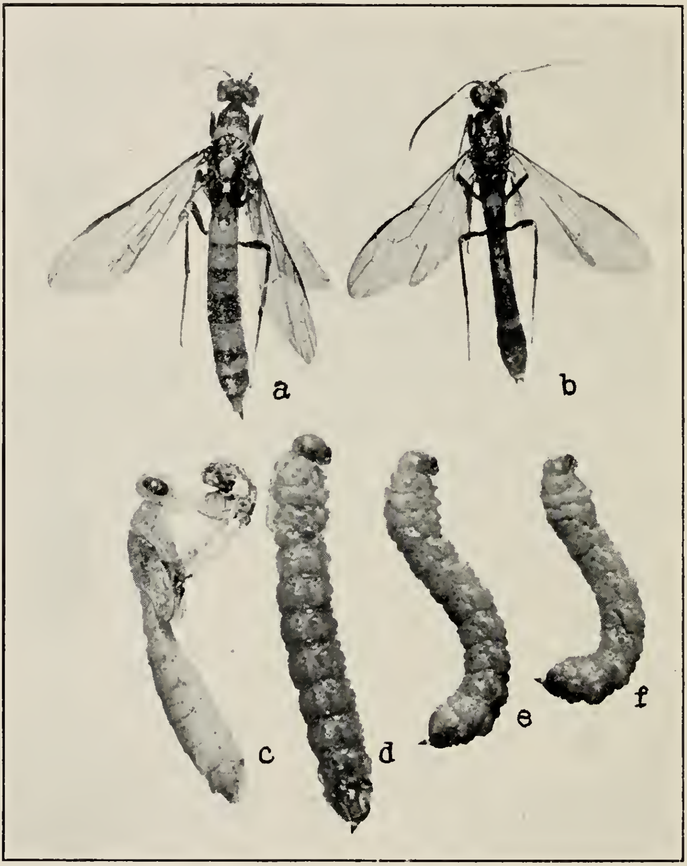

Fig. 282.—The raspberry horn-tail, *Hartigia cressoni.* a, adult female; b, adult male; c, well developed pupa; d, very young pupa; e and f, larvæ. (Essig, M. B. Cal. Hort Com.).

Distribution.—The central part of the State, more particularly in the foothill regions east of the Sacramento River.

Food Plants.—The native host of this insect is probably the wild rose. Raspberries suffer most from the attacks. Cultivated roses, blackberries and loganberries are also food plants.

Control.—Measures necessary to remove or destroy the eggs before the young larvæ hatch should be inaugurated. As the eggs are very tender and their locations plain, great numbers may be quickly destroyed by exerting a slight pressure over them with the fingers, which in no way injures the shoot. Cutting out infested canes is also recommended.

THE PEAR OR CHERRY SLUG.

Caliroa cerasi Linn. (Family Tenthredinidæ).

(*Eriocampoides limacina* Retz.)

(Fig. 283.)

General Appearance.—The adult is a glossy, black, four-winged insect about one fifth of an inch in length. The larvæ are dark olive green, slimy and from three eighths to nearly half an inch in length. Their work is very noticeable and consists in the removal of all of the upper green surface of the leaf, causing the injured areas to turn brown. Badly infested trees appear scorched as if by fire.

Life History.—The eggs are oval, slightly flattened on one side and deposited under the epidermis of the leaves, usually on the under sides, by the sharp ovipositor of the female. They hatch in about two weeks. The young larvæ cut a semi-circular hole in the upper surface of the leaf and begin to feed. They are first white and later become dark green, because of the slimy secretion. The entire green upper surface of the leaves is removed by the larvæ until only skeletons are left. The remaining under-surface turns brown. When full grown the larvæ crawl an inch or so into the ground and spin a cocoon in which to pupate and hibernate throughout the winter. The adults appear in the early spring.

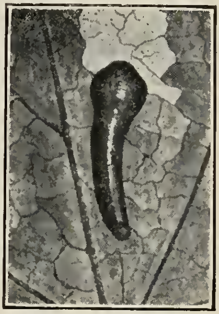

FIG. 283. — The pear or cherry slug (*Caliroa cerasi* Linn.) and its work upon the leaf. (After Ewing.)

Distribution.—Generally distributed throughout the State.

Food Plants.—Pear, cherry, plum, quince, button-bush, thorn, mountain-ash, *Amelanchier canadensis*.

Control.—This is one of the easiest pests to control. The larvæ readily succumb to the ordinary soap or emulsion sprays and may be effectually destroyed by blowing dust upon the infested leaves.

Natural Enemies.—Without doubt the reason for this pest not becoming more serious in California is due to the natural enemies which hold it in check. In this State these enemies have never been recorded but in the Middle States the egg parasites, *Pentarthron minutum* Riley and *Closterocerus cinctipennis* Ash., are quite common.

There are probably also parasites working on the larvæ. This, however, has never been definitely ascertained. The predaceous bug, *Podisus maculiventris* Say, and the Reduviid, *Sinea diadema* Fab., are active enemies of the larvæ and adults. The larvæ of the green lacewing also devour many of the young.

THE COMMON NEMATODE OR POTATO EELWORM.

Heterodera radicicola Greef.

(Figs. 284, 285.)

Eelworms belong to a phylum of animals far below insects and are never considered in a general work on entomology, but due to the seriousness as well as the wide distribution of this worm as a pest of crops, a brief account of it is herein included.

General Appearance.—The presence of this pest is told by such characteristic injuries as root knot on nursery trees, galls on tomato vines and the rough warty surface of potato tubers. The animal causing the injuries is commonly known as the nematode worm and was recently given much prominence as the potato eelworm. The males and young, the usual forms of the animal, are microscopic, transparent and shaped much like minute eels. The female is pear-shaped and pearly-white. The eggs are oval in shape and laid in great numbers.

Life History.—The young eelworms feed upon the roots of various plants causing galls or knots which may greatly impair growth. The female develops within the affected areas and begins egg-laying, the young hatching in a very short time afterwards. The winter is passed in the original host if it remains growing in the soil, such as nursery stock, but if the host is removed they feed upon various plants left in the fields. The young have the ability to encyst themselves so as to resist great extremes of weather and unfavorable conditions, so once in the soil it is very difficult to eradicate them.

Distribution.—As a producer of root knot this animal is very common throughout the state, but somewhat more abundant in the central and southern parts. As a potato pest it has been discovered only in Los Angeles, Nevada, Monterey and Inyo counties.

Food Plants.—According to Dr. E. A. Bessey there are four hundred and eighty species and subspecies of plants affected by root-knot. The list includes members of practically every flowering plant. Most of the garden plants are affected, as are many of the field crops and fruit trees. For definite information concerning the host plants the reader is referred to pp. 10-22, Bulletin 217, Bureau of Plant Industry, U. S. Dept. of Agriculture, by Dr. Bessey.

Control.—The control of this pest is extremely difficult and eradication almost impossible. In greenhouses the soil may be sterilized with steam or formaldehyde (one part to one hundred parts of water). Rotation of crops which are not attacked by the nematode is perhaps the best control measure in the field. Summer fallow, frequently turning

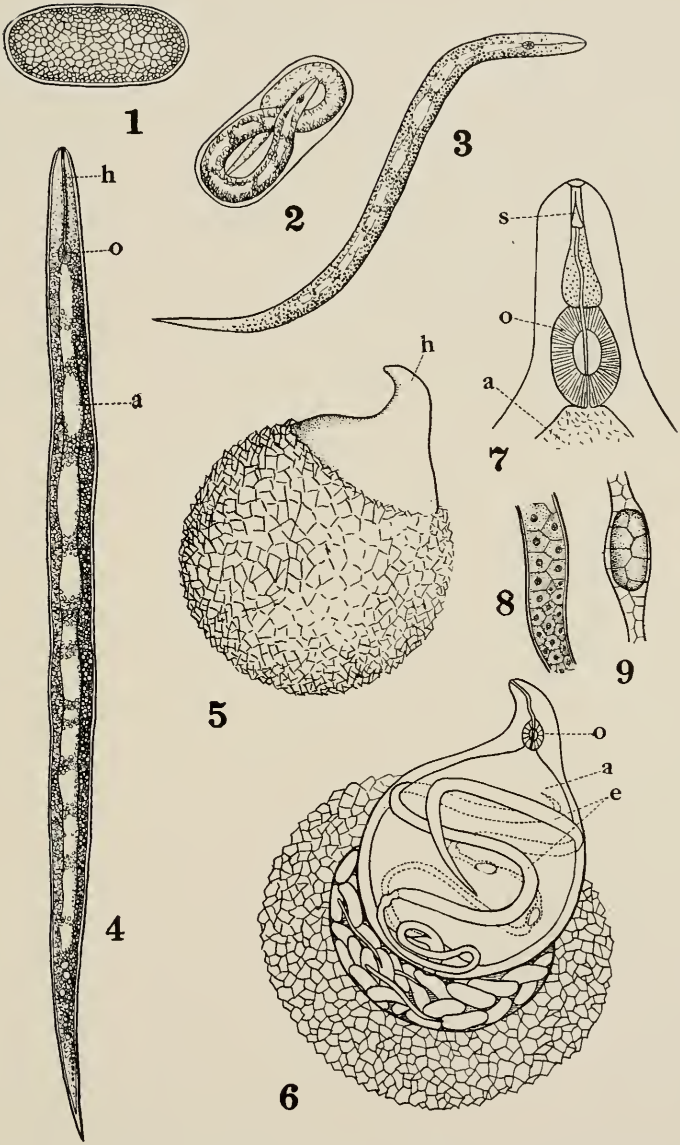

Fig. 284.—The common nematode or potato eelworm (*Heterodera radicicola* Greef). 1, egg, magnified 200 times; 2, egg, showing developing larva within; 3, young larva, magnified 200 times; 4, same, magnified 350 times; 5, adult female and gall, magnified 70 times; 6, same, opened, showing organs of female, and eggs and young larvæ as they are found in the gall; 7, head of female, greatly enlarged; 8, part of egg tube, showing forming eggs; 9, another part of tube, with a fully formed egg in it. a, alimentary canal; e, egg tubes; h, head; o, œsophagus; s, spear. (Drawing by Newcomer.)

up the soil and allowing it to dry out, will help to reduce the numbers. Irrigated districts are more liable to become infested and are very faverable to spread and difficult of control.

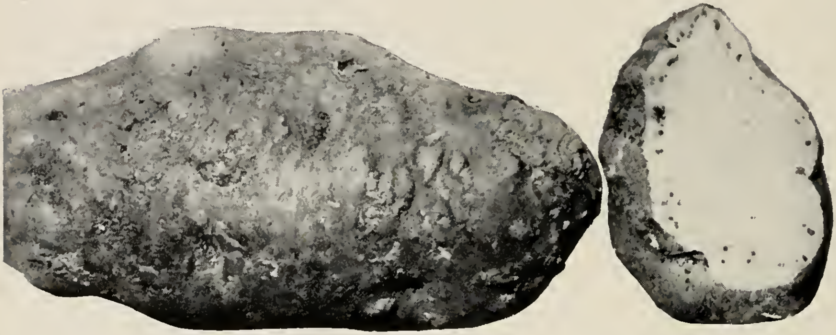

FIG. 285.—Potatoes showing the work of the common nematode or eelworm, *Heterodera radicicola* Greef. (Photograph by Bremner.)

INSECT COLLECTIONS.

A collection of the representative economic insects of California is of great value to the office of a county horticultural commissioner and the building up of such a collection is easy and exceedingly instructive. Every State or county official who is required to have a knowledge of insects cannot improve his spare moments to a greater advantage to himself or to his work.

Most of such officials thoroughly realize this and have already collected and preserved the most important insects of their respective counties. It is with the desire that all parties interested in building up an entomological collection will be helped that the following suggestions are made.

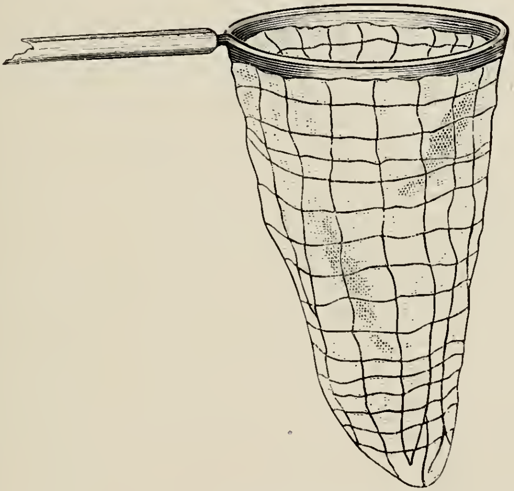

Fig. 286.—Insect net. The shape is excellent, but the netting is too frail. (After Riley.)

COLLECTING.

Most of the horticultural officials do not have time to greatly develop the collecting of insects as a specialized part of their work, and feeling this, some do not bother with it at all. It is not necessary or possible to build up a complete insect collection in one year, even by the most thorough and persistent efforts, but it is possible to gradually acquire a very representative lot of insects by careful observation in the orchards, vineyards, gardens and fields and capturing all specimens met with. Such officials should always carry suitable boxes or bottles for the preservation of insects thus acquired. Inspectors can greatly aid in this work. Fruit growers also bring in large numbers of insects for determination, which if kept and carefully mounted, add greatly to any growing collection. A true entomologist never goes anywhere in the open country without bringing back at least a few good specimens.

Nets.—A good net is indispensable for collecting insects. Most manufactured nets are entirely too frail for ordinary field work. A suitably shaped net is shown in Fig. 286, but the material should be heavy cheesecloth or coarse, loosely woven muslin. Such a net is especially recommended for sweeping or for capturing hard-bodied insects, as grasshoppers, crickets, katydids, beetles, bees, wasps, etc. For delicate and swift-flying insects, such as butterflies, moths, dragonflies, lacewings, etc., a durable netting should be used. An ordinary circular frame will do very well, but a more convenient style is the manufactured steel collapsible frame of a dip or landing fish net, which also has a jointed handle, and the whole can be easily carried in a traveling bag.

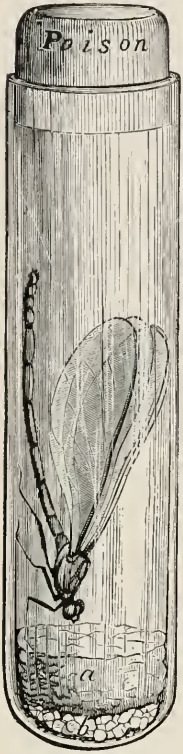

Fig. 287.—Pocket cyanide killing bottle. (After Riley.)

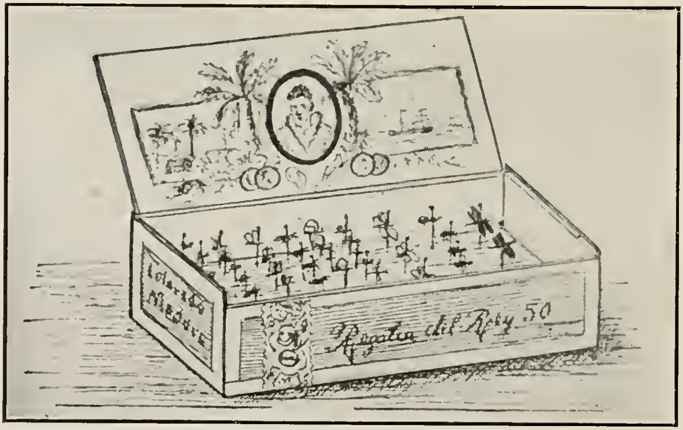

Fig. 288.—A temporary insect box.

KILLING.

Insects to be mounted and preserved should be killed as soon after collected as possible. The most popular method of killing is the use of a jar or can containing potassium or sodium cyanide. The cyanide may be kept in the bottom of the jar or can with plaster paris, or better, with suitable pieces of blotting paper, which absorb the moisture. The lid should be tight, so as to retain all of the fumes, and enough cyanide used to make the killing rapid. Small killing-vials, suitable for the pocket (Fig. 287), are very desirable and easily made. Baking powder cans are also excellent containers, as they cannot be broken, but due to the poor fitting of the lids need often to be refilled. In preparing such a can, cut a circular piece of blotter to cover the bottom; add the cyanide and pack cotton or other material tightly around it; cover all with several circular, tight-fitting pieces of blotter, and then cut another piece large enough to form a lining inside the can, reaching from the pieces holding the cyanide to the top. When the lid is on, this lining will hold the cyanide in the bottom of the can and is also an excellent absorbing surface for any excess moisture. All cyanide killing receptacles should be plainly marked poisonous.

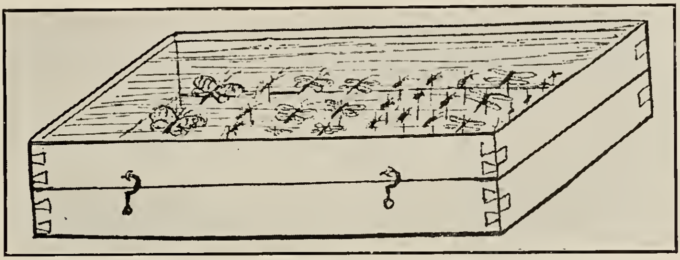

FIG 289.—Glass covered exhibition case for pinned insects.

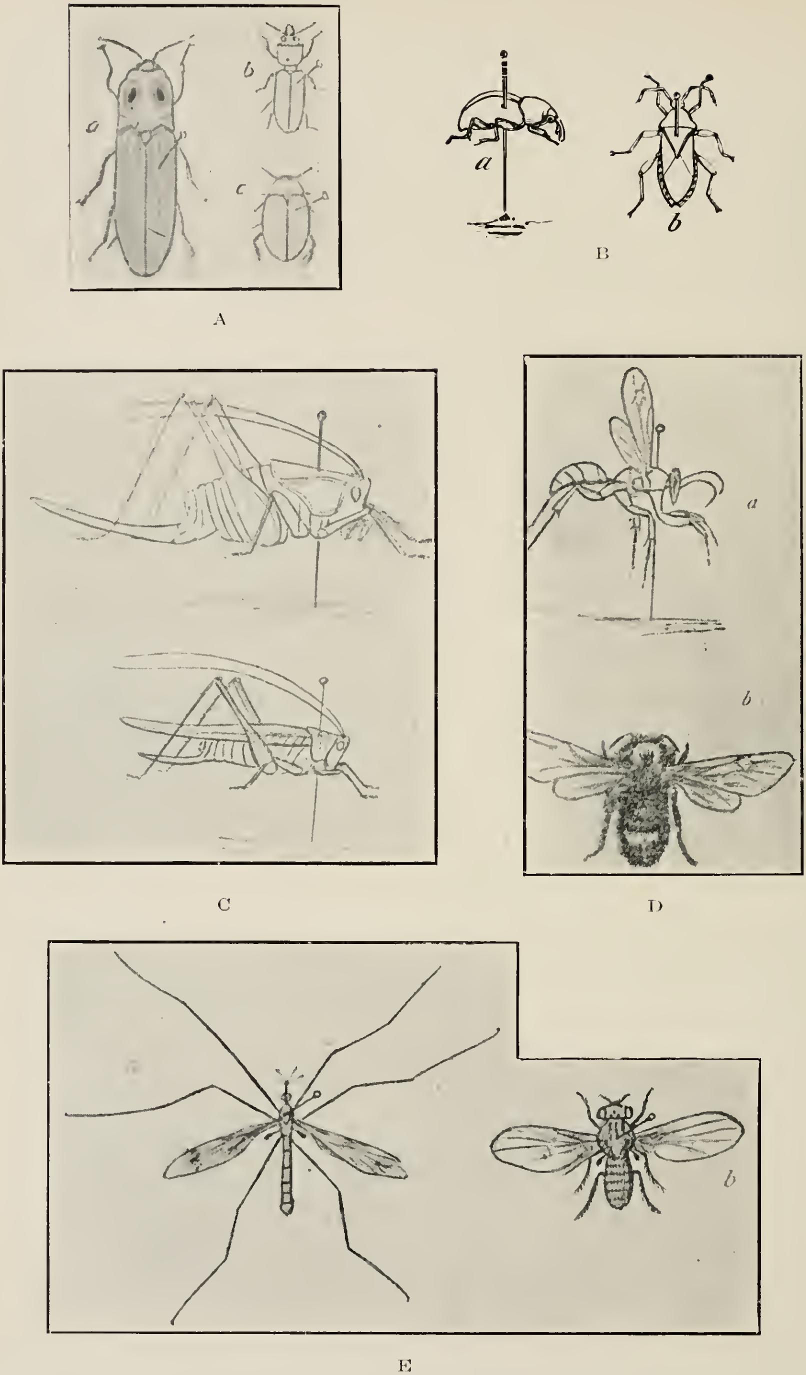

Fig. 290.—Methods of pinning insects. A, Coleoptera (beetles); B, Coleoptera and Hemiptera (beetles and Heteroptera—true bugs); C, Orthoptera (grasshoppers, katydids, crickets, etc.); D, Hymenoptera (wasps, bees, etc.); E, Diptera (two-winged flies).

MOUNTING.

There are various ways of mounting insects so as to show them off to the best advantage, to preserve them longest and most perfectly and to admit of their study. The most common methods are pinning directly into suitable cases, mounting in glass tubes or plaques, in glycerine or balsam on slides and in alcohol or formalin in specimen jars. All mounting work should be done as soon after the insects are killed as possible, to avoid breaking the appendages. However, if they are allowed to become dry and stiff they may be relaxed and safely mounted by being placed for from twelve to forty-eight hours in a moist chamber. In such cases care should be exercised to see that the specimens do not mould. A piece of blotting paper in the bottom treated with weak formalin will aid in avoiding this.

Pinning.—Nearly all insects are pinned, especially the larger and more chitinous ones, such as grasshoppers, beetles, true bugs, flies, butterflies, bees, etc., but the position on the pin varies considerably. All the members of certain orders are pinned, no matter how small, while in many, the small chitinous ones are stuck on points which are supported by pins. The usual method of pinning insects is to thrust the pin through the thorax, as shown in Fig. 290. All members of the orders *Diptera*, *Lepidoptera*, *Orthoptera*, *Hymenoptera* (except the exceedingly small forms), *Neuroptera* and *Platyptera*, are thus pinned. The *Orthoptera* and many of the *Hymenoptera* are usually pinned through the prothorax, while the others are pinned through the mesothorax.

True bugs of the suborder *Heteroptera* should be pinned through the scutellum, a small, usually triangular area just at the base of the abdomen (Fig. 290 B).

All beetles, except the small ones which are mounted upon points, are pinned through the right elytrum or wing cover near the base, as shown in Fig. 290 A and B.

Secondary Pinning.—Very small insects, especially *Diptera* and *Lepidoptera*, are mounted upon exceedingly fine pins supported upon one end of small pieces of pith, cork or cardboard, which are in turn supported upon regulation pins at the other ends. This allows the smallest specimens to be placed in the collection in a position not out of harmony with the largest ones.

Spreading.—Insects whose identity depends largely upon the venation and colorations of the wings are placed upon stretching boards (Fig. 291 D and E) when fresh or relaxed and the wings properly spread and allowed to thoroughly dry before they are placed into permanent cabinets. The hind margins of the front wings of a stretched insect should be at right angles to the main axis of the body, as shown in Fig. 291.

Butterflies and moths collected in large numbers may be safely pre-

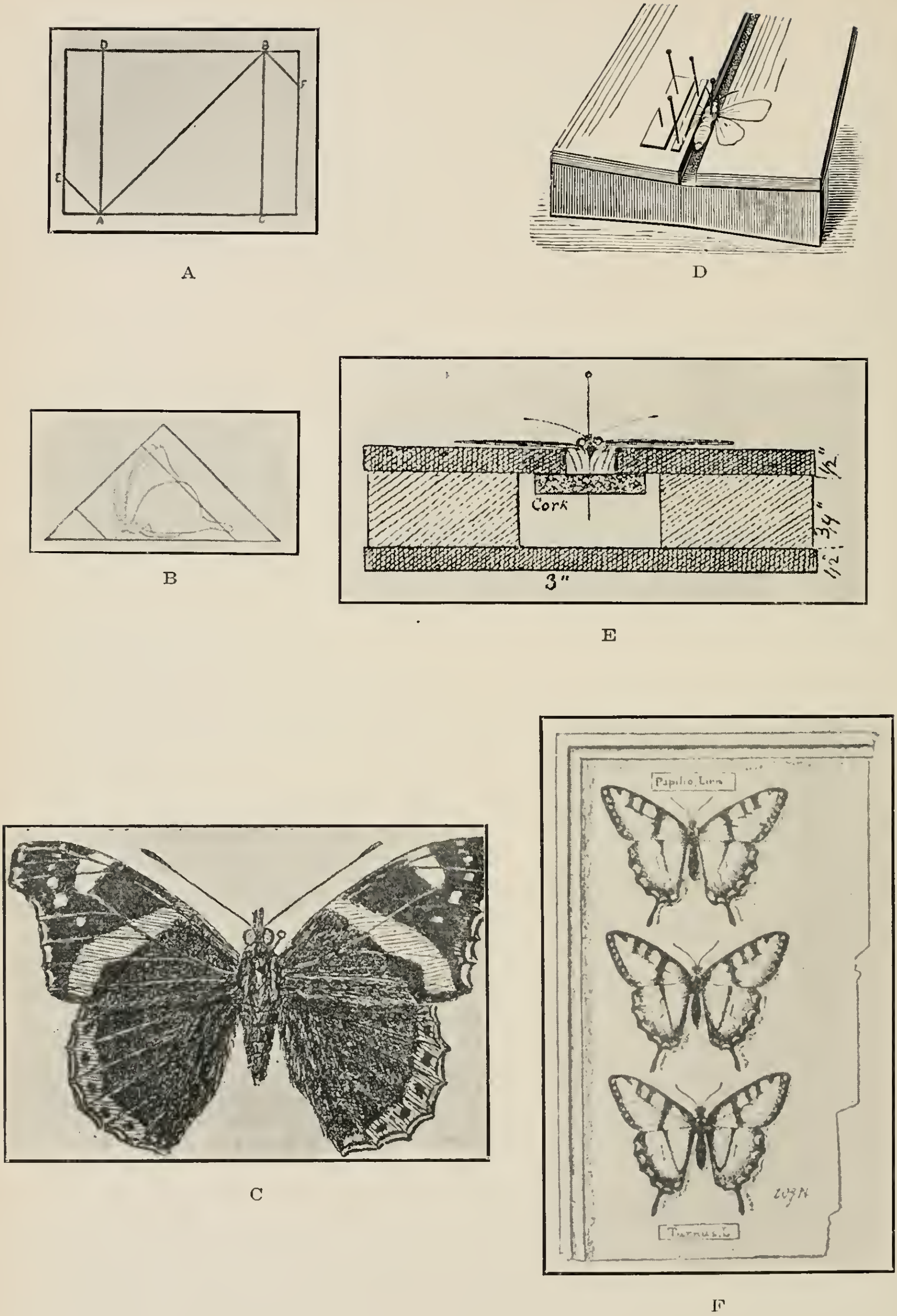
D
B
F
E
A
C
A
D
B
Cork
1/2"
3/4"
1/2"
3"
E
Papilio Linn
Turnus L.
C
F

FIG. 291.—Mounting Lepidoptera. A, triangle showing method of folding paper. First fold on line A B, then on A D and C B, and then on B F and E A; B, specimen in folded triangle; C, pinned specimen; D, method of stretching; E, cross-section of stretching board; F, specimens placed in permanent cabinet.

served in small paper triangles, as shown in Fig. 291 B, until ready for spreading. If so kept they become dry and brittle and should be kept in a moist chamber until completely relaxed before they are placed upon the stretching board.

Points.—All small insects which are chitinous enough to retain their original form when dry, such as small members of the orders *Coleoptera*, *Hymenoptera* and of the suborder *Homoptera* (excepting the families *Aphididæ* and *Coccidæ*), in fact practically all small insects excepting true flies (*Diptera*) should be mounted upon small cardboard or celluloid points (Fig. 292). White shellac or beetle glue* is used to fasten the insects to the tips of the points. The size of the points vary somewhat but one adapted to all needs should be 9 mm. long, 1 mm. wide at the base and gradually tapering to a blunt point. The insect should be mounted so that it faces from you when the pin is to the right of it, as shown in Fig. 292. Care should be exercised to see that the specimen is straight, at right angles to the point and that all appendages are free. Ladybird beetles (*Coccinellidæ*) should be mounted so that the points do not reach quite to the middle of the sternum.

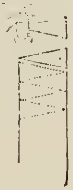

Fig. 292.—A specimen properly mounted upon a point. (After Riley.)

CASES FOR PINNED INSECTS.

By far the most satisfactory containers for pinned insects are the Schmitt insect boxes which are dust and insect proof. Specially constructed cases with glass tops are excellent for exhibition purposes. Small sacks or balls of naphtha should be pinned in the corners to aid in keeping out insects destructive to specimens.

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*Beetle glue is prepared as follows:

Water	45 parts
Alcohol (95 per cent)	8 parts
Carbolic acid	2 parts
Sugar	30 parts
Gum arabic	60 parts

GLASS TUBES.

Scale insects (*Coccidæ*) are easily handled and preserved in small glass shell vials, as shown in Fig. 293. Life histories of other insects for exhibition purposes may also be mounted in small or large glass tubes.

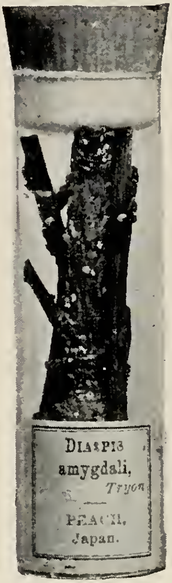

Fig. 293. — Specimens of scale insect in a glass vial. (Cal. Hort. Com.)

PLAQUES OR GLASS MOUNTS.

Nearly all insects may be mounted in plaques with glass facing and cardboard backs. These make excellent exhibits to hang upon the walls. Special mounts are prepared in the form of small cardboard boxes filled with cotton upon which the specimens rest and fitted with a glass faced cover.

GLYCERINE.

Certain small soft-bodied scale insects, plant lice, young bugs, larvæ, etc., are often mounted directly on glass slides under a glass cover in glycerine prepared by adding one part of acetic acid to ten parts of glycerine jelly. Specimens may be mounted directly into this or previously prepared as directed for mounting in Canada balsam.

CANADA BALSAM.

For microscopical study, scale insects, plant lice, thrips, mites, etc., are permanently mounted on slides in Canada balsam which has been dissolved in xylol. Specimens are mounted directly in the balsam either alive or freshly killed, and when so done usually retain their original shapes perfectly, but are not suitable for microscopic study for several months. By far the most satisfactory method of mounting scale insects is to first boil them in potassium hydroxide (KOH) or sodium hydroxide (NaOH); thoroughly wash them in water; dehydrate by carrying through solutions of 30 per cent, 78 per cent and 95 per cent or absolute alcohol; clear in xylol, cedar oil or clove oil and mount directly into balsam.

An excellent method of mounting the others listed above is as follows: Kill by pouring over them boiling 95 per cent or absolute alcohol; clear in xylol, cedar oil or clove oil, and mount directly into balsam. Glass slides and cover glasses are necessary for such mounts.

PRESERVING LARVÆ.

Caterpillars or the larvæ of moths and butterflies are very often preserved by the inflating method, which consists in removing the viscera, inflating the body and drying them over an oven until rigid. The original color and much of the vestiture are thus retained in almost perfect condition. The caterpillar of the red humped caterpillar, shown in Fig. 175, has been thus cured.

Caterpillars and the larvæ of other insects are also excellently preserved by first boiling them in water and placing them directly in a permanent solution prepared as follows:

Alcohol (97 per cent)	15 c.c.
Formalin (40 per cent)	15 c.c.
Water (distilled)	120 c.c.

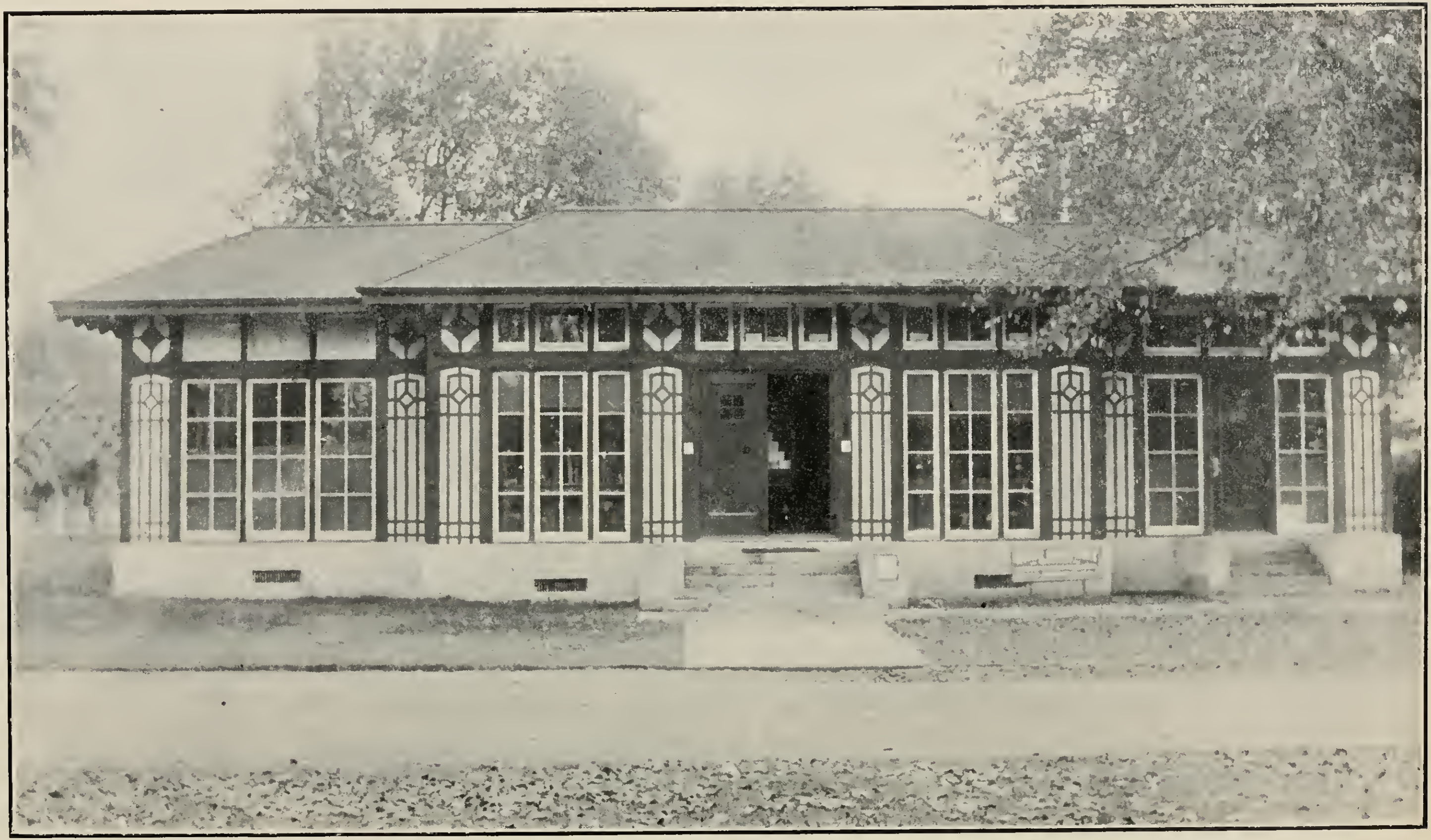

FIG. 294.—The State Insectary. (Courtesy State Engineering Dept.)

THE STATE INSECTARY.

For the introduction, breeding and dissemination of beneficial predaceous and parasitic insects a special department has been created in the office of the State Commissioner of Horticulture, known as the insectary division. The officers of this division are provided for by law, the chief of which is known as the Superintendent of the State Insectary. The State Insectary was constructed especially for the rearing and breeding of beneficial insects and is located in the Capitol Park at Sacramento. It is supported by appropriations of the State Legislature, and is, therefore, a free institution to all the citizens of the State.

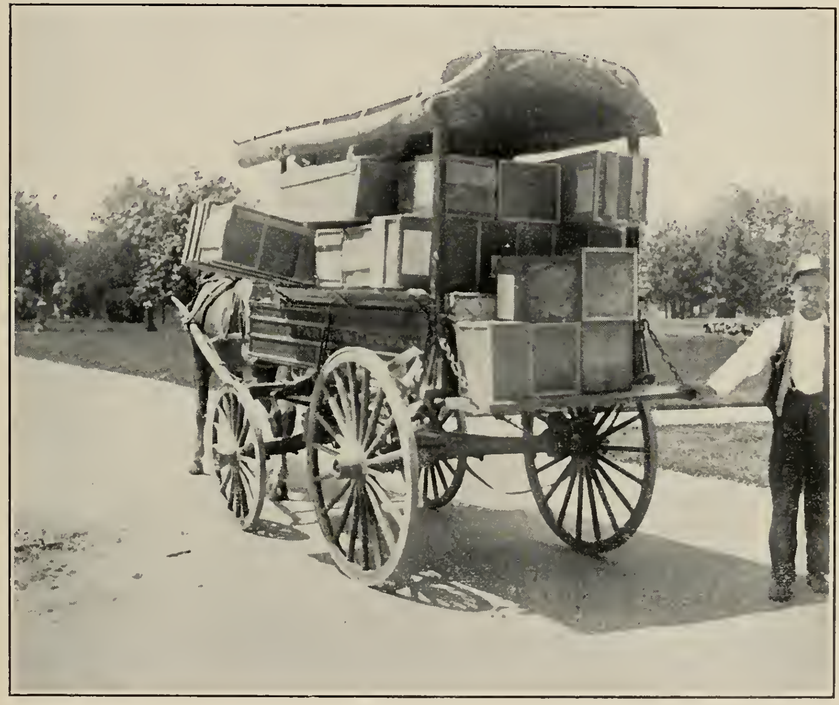

Fig. 295.—Beneficial insects are expressed from the insectary directly to the growers. (Carnes. M. B. Cal. Hort. Com.)

The operations of the insectary are briefly as follows: Expert entomologists are kept in the fields in California and in other states and countries, who collect natural enemies of destructive insects. These are forwarded to the insectary where they are supplied with the proper hosts and reared in sufficient numbers to be sent out into the sections of the State where the destructive insect pests, upon which they prey, are found. To properly conduct the work requires great skill upon the part of the collectors and those in charge of the breeding work.

At the present time a very strenuous effort is being made to bring this work in closer touch with the great problems of insect control. Mr. Harry S. Smith, who has for many years been in charge of parasitic work for the Bureau of Entomology of the U. S. Department of Agriculture, became superintendent January 1, 1913, and is thoroughly organizing the work along up-to-date and scientific lines. A specialist is to be sent to foreign countries in the spring, while local assistants are to explore the State for native species. Mr. Smith will also make it a point to secure all possible parasites and predaceous insects in the United States. He is thoroughly qualified for the position he now holds and is alive to the great needs and possibilities along these lines.

All fruit growers are invited to keep in close touch with the State Insectary and to make their wants known. It must be remembered, however, that results from breeding insects are often exceedingly slow and uncertain, and that it will be some time before new importations can be placed in the orchards. Likewise parasites and predaceous insects sent out into the orchards require several years at least before they are thoroughly established and become controlling factors.

SPRAYS AND POISONS.

Spraying for insect pests has become a very important factor in the growing of all crops and especially in horticultural work. As such it is now a regular and well established business, which has received a tremendous amount of investigation work, with the results that there is on the market a spray for every individual ailment a tree or plant is heir to. This is true of both the home-made and commercial products and it has become an exceedingly difficult task for the orchardist or farmer to select a spray which is to give the best results for the financial outlay.

It is beyond the limits of any ordinary work to give a complete list of the formulæ and uses of all these preparations, and should this be done the results would prove unsatisfactory. It is therefore the aim of the writer to include only those preparations which are known to give definite and reliable results.

In general insecticidal sprays and powders are listed in three main classes, viz: poison sprays, contact sprays and repellents. The poison sprays are used in controlling biting and chewing insects which are capable of taking the poison internally; while the contact sprays are for piercing and sucking insects which cannot be controlled by poison sprays. The repellents do not kill, but applied to the plants or soils, serve to drive the pests away and thus prevent attacks.

POISON INSECTICIDES FOR CHEWING INSECTS.

Poisoned sprays are usually made of arsenical compounds and are therefore known as arsenical sprays or insecticides. Formerly Paris green and London purple were used but of late years it has been found that lead arsenate and zinc arsenite are as efficient, cheaper and do less damage to the fruit and foliage.

These sprays are used in combatting leaf eating insects, such as grasshoppers, army and cut worms, tent caterpillars, red-humped caterpillars, tomato and tobacco worms, cabbage worms, pear slugs, beetles, etc.

LEAD ARSENATE.

No. 1. Commercially prepared.

Lead arsenate (paste)	6 to 8 pounds
Water	100 gallons

No. 2. Arsenate of lead (powder)	2 to 8 pounds
Water	100 gallons

Preparation.—Simply dissolve the paste or powder in the required amount of water or in a small amount and add the remainder for use.

No. 3. Home-made preparations.

Acetate of lead	44 ounces
Arsenate of soda	16 ounces
Water	100 gallons

Preparation.—Dissolve the acetate of lead (sugar of lead) in 4 gallons of water in a wooden container; in another pail dissolve the arsenate of soda in 2 gallons of water. These two solutions poured together will make 100 gallons of spraying material.

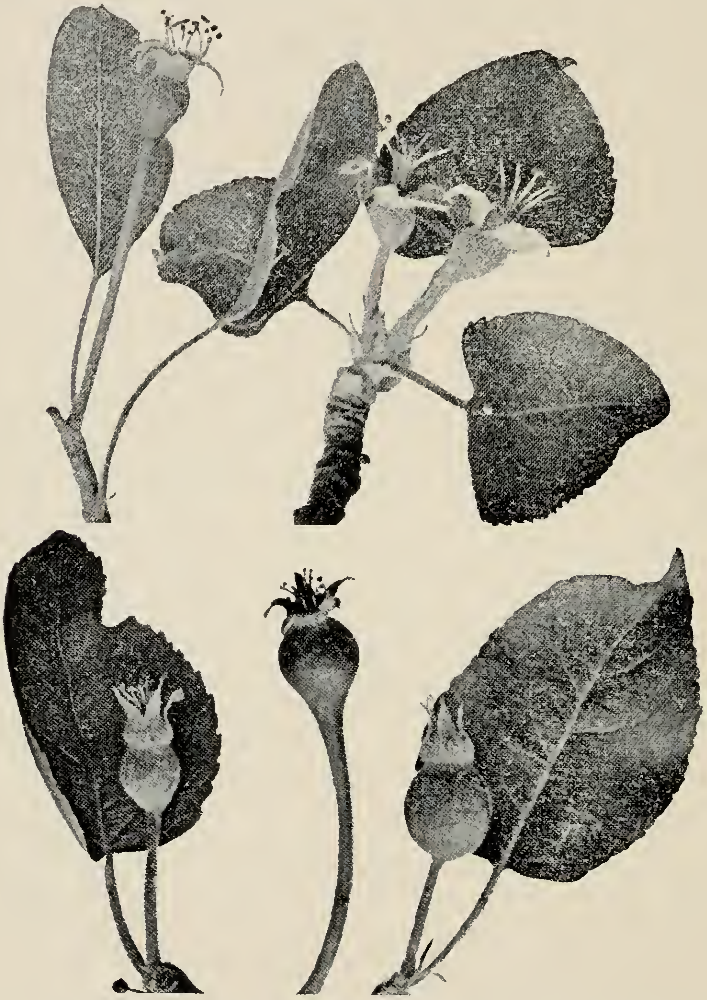

Fig. 296.—Top picture shows the young apples just right to spray for the codling moth—the calyx lobes are open. The lower picture shows apples too far advanced to spray for this pest—the calyx lobes are closed. (After Slingerland.)

ARSENATE OF LEAD AND BORDEAUX MIXTURE.

It is often desirable to use a combination arsenical spray with a fungicide for scab and codling moth. With Bordeaux mixture use four pounds of arsenate of lead to one hundred gallons of the preparation when ready to apply to the trees.

LEAD ARSENATE AND LIME-SULPHUR.

A combination arsenical and fungicidal spray may also be made by adding five pounds of arsenate of lead to every one hundred gallons of the lime-sulphur after it is properly diluted for spraying.

PARIS GREEN.

If lead arsenate cannot be had, Paris green may be used as follows:

Paris green	10 ounces
Air-slaked lime	2 pounds
Water	100 gallons

First slake the lime, stir the poison into a thin paste with a little water, add this to the lime, then strain the mixture through a sieve into a tank containing the required amount of water. If it is desired to spray for both fungi and insects on peaches or other tender foliage two hundred gallons of water should be used. *It is necessary to keep this mixture well agitated while spraying.*

As a dust Paris green is mixed as follows:

Paris green	5 ounces
Air-slaked lime	1 pound

The Paris green and lime are thoroughly powdered, mixed and dusted upon the plants through a muslin bag or by means of a blower.

In combination with Bordeaux mixture or lime-sulphur add eight ounces of Paris green to every one hundred gallons of the diluted spray.

POISON BAITS.

Poison baits occupy a very important place in the control of certain insects, such as grasshoppers, army and cutworms, wireworms, etc., and are especially useful to the small gardener though they have often been used with excellent results in large fields and orchards.

POISON BRAN MASH.

No. 1.

Bran	25 pounds
Paris green	½ pound
Cheap molasses	1 quart

No. 2.

Bran	40 pounds
Arsenic	5 pounds
Molasses	2 gallons

In preparing these mix the arsenic or Paris green and bran dry, and add the molasses, which has been diluted in water. Add enough more water to moisten the bran so that it will appear between the fingers when the mixture is squeezed in the hand.

Some prefer to moisten the bran first and afterwards stir in the molasses and poison.

CRIDDLE MIXTURE.

Though this mixture is somewhat disagreeable to make and handle, it is exceedingly cheap and affective, especially for grasshoppers.

Fresh horse dung	60 pounds
Common salt	2 pounds
Paris green	1 pound

The Paris green is mixed with enough water to form a paste and is then stirred thoroughly into the horse dung with the salt.

These poisoned baits are scattered about in fields infested with grasshoppers, army and cutworms and various other destructive chewing insects or they may be placed in advance of the oncoming hordes. A very important thing in handling the poisoned baits is to see that they are kept moistened all the time, as they become worthless when dry. To prevent this drying out the mixture should be put out in small piles and occasionally moistened. They may also be placed under boards or in the shade, while for cutworms and wireworms it is often advisable to bury them in the ground.

CONTACT INSECTICIDES FOR SUCKING INSECTS.

LIQUIDS.

Lime-sulphur is easily the most important insecticidal spray now used and its fungicidal properties make it even more useful to the orchardist. It is especially valuable for controlling scale insects and fungi on deciduous fruit trees, though if properly weakened it may also be used as a summer spray, particularly for the citrus and almond spiders.

Formerly lime-sulphur spray was a home-made product, but today the commercially prepared product is so superior to the home-made mixtures that the latter have almost ceased to exist.

HOME-MADE LIME-SULPHUR.

Formula.

Lime	40 pounds
Sulphur (flowers)	30 pounds
Water to make	100 gallons

Preparation.—Heat in a cooking barrel or vessel about one third of the total quantity of water required. When the water is hot, add all of the lime, and at once add all the sulphur, which should previously have been made into a thick paste with water. After the lime is slaked, another third of the water should be added, preferably hot, and the cooking should be continued for an hour, when the final dilution may be made, using either hot or cold water as is most convenient. The boiling due to the slaking of lime thoroughly mixes the ingredients at the start, but subsequent stirring is necessary if the wash is cooked by direct heat in kettles. After the wash has been prepared it must be strained through a fine sieve as it is being run into the spray tank.

COMMERCIAL LIME-SULPHUR.

The commercial spray is a perfectly clear liquid, easy to handle and needing only to be properly diluted for use. It is usually sold in barrel lots. There are two common brands upon the market in California, sold under the trade names, "Rex" and "Ortho," though there are other sprays equally as good manufactured elsewhere.

For spraying scale insects on dormant, deciduous fruit trees in the winter, the commercial lime-sulphur should be diluted one to nine of water. It is advisable to spray just as early in the winter, after the leaves have fallen, as possible. If there is to be no confusion relative to the proper dilution of the commercial sprays a Baumé hydrometer should be employed. For winter spraying the following table by W. C. O'Kane is of great value:

Reading of hydrometer in degrees Baume.	Number of gallons of water to one gallon of the concentrate.
35	9
34	8¾
33	8¼
32	8
31	7½
30	7¼
29	6¾
28	6½
27	6
26	5¾
25	5¼
24	5
23	4½
22	4¼
21	3¾
20	3½
19	3¼
18	3
17	2¾
16	2½
15	2¼
14	2

For red spider on citrus trees these products are applied as a two per cent solution.

LIME-SULPHUR AND FLOUR PASTE.

For spraying trees in foliage and tender plants a lime-sulphur flour paste spray has given remarkably good results. The following formulæ are recommended:

No. 1.

Water	200 gallons
Flour paste, 8 pounds flour in	8 gallons water
Sublimed sulphur	10 pounds
Lime-sulphur solution	2½ gallons

The flour is first made into a thin paste by adding one pound to each gallon of water, according to the above formula. The sulphur is made into a paste also and added with the flour paste and lime-sulphur solution to the two hundred gallons of water in the spray tank. This spray is excellent for the red spiders on almond and citrus trees. Minus the lime-sulphur solution it is a very effective spray for the yellow mite (*Tetranychus bimaculatus*) on hops.

No. 2. (Iron Sulphide).

Water	200 gallons
Flour paste, 8 pounds flour in	8 gallons water
Lime-sulphur solution	2½ gallons
Iron sulphate	4 pounds

This spray is mixed as the preceding, and the iron sulphate after being dissolved is added directly to the diluted mixture in the tank.

The above spray is especially recommended for late summer sprayings for red spider on almond and citrus trees, but should not be applied to fruit trees just before the fruit is ready to pick, as the fruit might be stained.

EMULSIONS.

Emulsions are oily sprays in which soap is used as an emulsifying agent. They are especially valuable where high power of penetration is necessary or where there is a waxy covering to overcome, as in the case of woolly aphis, mealy bugs, etc. They also have the power of rapid and even distribution over the sprayed surface. If properly prepared, emulsions and water mix easily without agitation and are suitable for spraying tough and tender foliage alike.

Certain commercial emulsions are made by breaking up the oils into exceedingly small particles, thus forming a creamy liquid which readily mixes with water.

KEROSENE EMULSION.

Whale oil soap	40 pounds
Water	2 gallons
Kerosene	4 gallons

First dissolve the pound of soap in two gallons of hot soft water. When this is accomplished add the kerosene and agitate vigorously by pumping it back into itself until a thick creamy liquid results. This makes the stock solution.

For use on dormant trees and plants in the winter dilute the stock solution one to five of water. On trees or plants in foliage dilute with ten parts of water.

In giving directions for diluting kerosene emulsion many writers recommend the use of a certain per cent. This is exceedingly confusing to the average orchardist, and in order to have the information necessary to follow these recommendations the following dilutions showing per cent of strength are taken from O'Kane.*

For 4% strength add 15⅔ gallons of water to 1 gallon of stock solution
For 5% strength add 12⅓ gallons of water to 1 gallon of stock solution
For 7% strength add 8½ gallons of water to 1 gallon of stock solution
For 10% strength add 5⅔ gallons of water to 1 gallon of stock solution
For 12% strength add 4½ gallons of water to 1 gallon of stock solution
For 15% strength add 3½ gallons of water to 1 gallon of stock solution
For 18% strength add 2⅔ gallons of water to 1 gallon of stock solution
For 20% strength add 2⅓ gallons of water to 1 gallon of stock solution
For 25% strength add 1⅔ gallons of water to 1 gallon of stock solution

DISTILLATE EMULSION.

Distillate (28 degrees Baumé)	20 gallons
Whale oil soap	30 pounds
Water to mix	12 gallons

Dissolve the whale oil soap in the water, heating it to the boiling point; add the distillate and agitate thoroughly while the solution is hot. For use add twenty gallons of water to each gallon of the above mixture

CARBOLIC ACID EMULSION.

Whale oil soap	40 pounds
Crude carbolic acid	5 gallons
Water to mix	40 gallons

Dissolve the soap in hot water (the soap must be entirely dissolved); add the carbolic acid and heat to the boiling point for twenty minutes (reserve some water to add in case the mixture begins to boil over). For use add twenty gallons of water to every gallon of the above stock solution. The emulsion needs little or no agitation.

This spray is especially recommended for mealy bugs, but is also suitable for plant lice and soft brown scale. It is also a good contact insecticide for ants.

CRUDE OIL EMULSION.

Water	175 gallons
Liquid soap	3 gallons
Crude oil	25 gallons

Fill the spray tank with the 175 gallons of water; add the liquid soap; agitate thoroughly for one minute, after which add the crude oil, continuing the agitation.

If the liquid soap cannot be had, use 20 pounds whale oil soap, dissolved in 10 gallons of boiling water, to which three pounds of lye have been added.

During the spraying operation this mixture should be thoroughly agitated and great care taken to wet all of the twigs. From 8 to 15 gallons should be used on a tree. The application should be made from November to February.

The crude oil emulsion is especially recommended for black scale

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*Injurious Insects, W. C. O'Kane, p. 74.

(*Saissetia oleæ*), European fruit scale (*Lecanium corni*), European pear scale (*Epidiaspis piricola*), cherry scale (*Eulecanium cerasorum*) and other scales infesting deciduous fruit trees. It should be applied in the winter, when the trees are dormant.

To also kill moss or lichens on fruit trees add two pounds of lye to the formula of the stock solution.

DISTILLATE OIL MECHANICAL MIXTURE.

Water	200 gallons
Caustic soda (95 per cent)	7 pounds
Distillate (28 degrees Baumé)	10 gallons

Fill spray tank with the required amount of water; add the caustic soda, which has been dissolved in a small amount of water and then the distillate. Keep agitator going rapidly while applying the spray.

This spray has been thoroughly tested by the writer and is one of the cheapest and best for spraying black scale (*Saissetia oleæ*) or the European fruit scale (*Lecanium corni*) on apricot and olive trees.

DISTILLATE EMULSION AND TOBACCO.

(Government Formula for Pear Thrips.)

Water	12 gallons
Whale oil soap	30 pounds
Distillate (32 to 34 degrees Baumé)	20 pounds

The above emulsion is prepared in the ordinary way as a stock solution. For use in the orchard dilute one to twenty parts of water. To every two hundred gallons of this diluted spray add one pint of tobacco extract containing forty per cent nicotine or about three and one half gallons of tobacco extract containing 2¾ per cent nicotine.

This spray is especially recommended for pear thrips.

RESIN WASH.

Though not a true emulsion and fast losing prominence as a spray, this wash is included here because of its value as a spray and dip for plants with tender foliage.

Resin	10 pounds
Caustic soda (76 per cent)	3 pounds
Fish oil	1½ pounds
Water	50 gallons

Put oil, resin and a gallon of water in an iron kettle and heat until the resin is softened; add the lye (dissolved in a small amount of water) and stir thoroughly, after which add enough water to make fifty gallons of spraying material.

This wash is only effective for young scale insects, plant lice, or other soft-bodied insects.

SOAP WASHES.

A simple and easily prepared spray for use in small gardens is made from soap as follows:

Whale oil or hard laundry soap	1 pound
Water	5 gallons

The soap is first dissolved in a small amount of hot water and the remainder added afterwards. This spray will not injure tender plants or foliage, and is recommended only for young scale insects, plant lice and other soft-bodied insects.

TOBACCO DECOCTIONS.

For soft-bodied insects in greenhouses, conservatories, or on house plants, as well as for plant lice, leaf hoppers and other similar insects in the open, the tobacco decoctions are invaluable because they do not injure the foliage and give excellent killing results.

Home-made Extract.

Tobacco leaves or stems	1 pound
Water	4 gallons

Steep the tobacco in the hot water and apply directly.

Commercial Extracts.

The extract containing 2¾ per cent nicotine should be diluted to sixty parts of water. The extract containing 40 per cent nicotine should be diluted from one to one thousand parts or one to fifteen hundred parts of water.

DUSTS.

A number of valuable insecticides are applied dry as dusts. We have already referred to Paris green and lime as being used in this way. Dusts are easy to mix and handle and are often of great service to the farmer and orchardist.

FLOWERS OF SULPHUR.

For a number of years flowers of sulphur was used alone as a remedy for mites on citrus and almond trees. It was distributed over the trees by hand or with a blower in the early morning when the foliage was damp, thus enabling it to adhere. The warm sunshine oxidizes the sulphur, the liberated sulphur-dioxide being the killing factor. Accordingly sulphur is of little avail in the cool summer weather of the coast counties or during the winter months anywhere. However, in the warm interior districts this is still a very effective remedy for mites.

LIME AND SULPHUR.

Even better than sulphur alone is dehydrated lime and flowers of sulphur mixed in equal parts and blown upon the trees with a power machine, as is shown in Fig. 304. In the citrus orchards this is a very important method of controlling the citrus red spider (*Tetranychus mytilaspidis*) and the six-spotted or yellow mite (*Tetranychus bimaculatus*).

LIME, SULPHUR AND SAL BORDEAUX.

This mixture is prepared as follows:

Dehydrated lime (finely powdered slaked lime)	40 pounds
Flowers of sulphur	5 pounds
Sal Bordeaux (a mixture of bluestone, charcoal and naphthol)	5 pounds

Mix these ingredients thoroughly and apply with a power blower. This is one of the most efficient preparations now being used in controlling the almond red spider (*Bryobia pratensis*).

PYRETHRUM.

This is commonly known as Persian or Dalmatian insect powder, or Buhach, and comes as a finely ground yellow powder with a pleasant, rather pungent odor. It is a contact poison and most larvæ and soft-bodied insects are thrown into convulsions when they come under its influence. Unfortunately it is not only expensive but quickly loses its effectiveness when exposed to the air. Its practical range is therefore limited, and it is chiefly used on house plants, in the conservatory and in the garden. It is entirely harmless to vegetation of all kinds and does not spot or mark even the most delicate flowers when used dry. It acts a little more promptly and effectively if applied to the insects while they are moist, or at least damp. If the dusty appearance is objectionable, a decoction may be made by steeping one ounce in one quart of boiling water, and then adding two or three quarts of cold water. Into this material potted plants may be dipped, or it may be applied with an atomizer. Against plant lice on house plants this makes a very clean and effective application.

HELLEBORE.

Powdered white hellebore has been used for many years as a specific remedy against "currant worms," "rose slugs" and other saw-fly larvæ, and is very effective, either dusted on as a powder, or in the form of a decoction. In the field it is now quite generally replaced by arsenate of lead or even Paris green, but in the garden it still holds its own. When applied, it may be used pure, or it may be mixed with two or three times its own weight of dust, cheap flour, lime, or almost any other light, finely powdered material. When used as a spray, steep one ounce in one quart of boiling water and add another quart of cold water when ready to apply.

It is also quite effective against certain root maggots, like those affecting cabbage and cauliflower. For these it is used in the form of a decoction, one ounce in one gallon of water and about half a pint poured around an infested plant, from which the earth has been drawn away to facilitate soaking directly around the plants. To be effective, the material must be brought into direct contact with the insects. Hence, it should be liberally used and applied before the maggots get down too far, or into the plant too deeply. In the garden its use is quite practical; in the field it has not been found so satisfactory.

REPELLENTS.

It is apparent that certain materials, applied to the foliage of plants, are somewhat repulsive to some insects. One of the most important of these repellents is the well known fungicide, Bordeaux mixture. Because of this and its use as a combined insecticide and fungicide the formula and directions for making are here presented quite fully.

BORDEAUX MIXTURE.

Unslaked lime	4 pounds
Copper sulphate (bluestone)	4 pounds
Water	50 gallons

The task of mixing these chemicals, where large quantities of the spray is used, is no small thing in itself. A great deal of study has been given to the construction of suitable mixing apparatus.

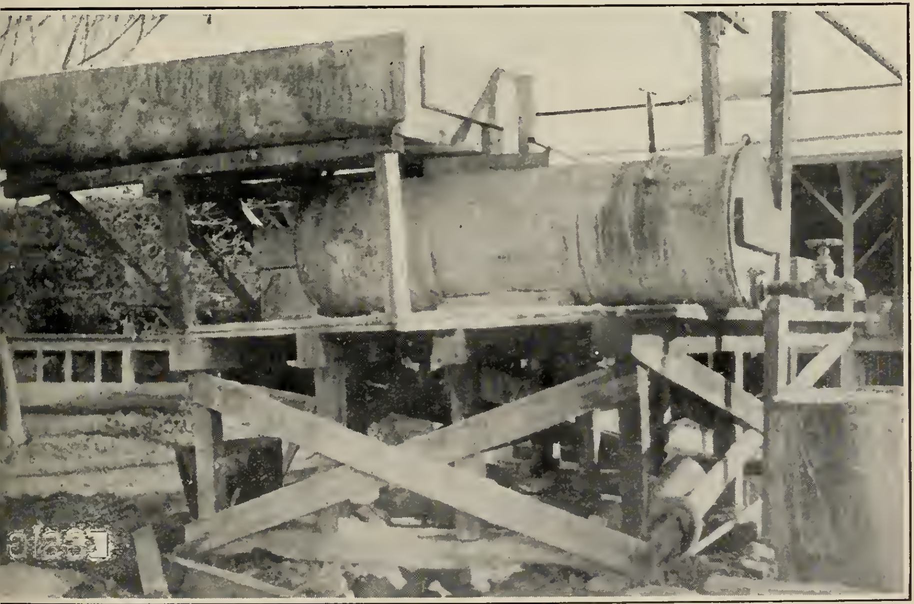

Fig. 297.—Apparatus for preparing Bordeaux mixture. The lime is first slaked in the shallow vat above and mixed with the required amount of water in the lower tank from which it is drawn off into the spray tank containing the diluted bluestone. A cross-section of the mixing tank is shown in Figure 298. (Original.)

The first consideration is to get the materials high enough on a platform so that they can be easily and rapidly placed in the spraying tanks of the power machines. This is done by constructing at convenient places in the orchard, platforms large enough to hold a large box for slaking lime, a lime solution agitator, and a vat for dissolving the bluestone. Such a platform is about 12 feet square and 4½ feet high (Fig. 297). A large standpipe for filling the tanks is desirable or the water must be pumped into the tank while the solutions are being added.

The lime is first slaked in a common vat for that purpose. The great trouble has always been to keep the slaked lime agitated properly when it was being drawn off to mix with the bluestone in the spraying tank. This problem has been solved by the use of a special agitator for this purpose (Fig. 298). The lime from the slaking vat is strained into this tank through the slanting bottomed strainer. The agitator works by means of a hand lever and the contents of the tank may be thoroughly mixed in a few minutes before it is drawn off for use. Here it is again strained through the strainer shown in Fig. 299 B, as well as is the bluestone.

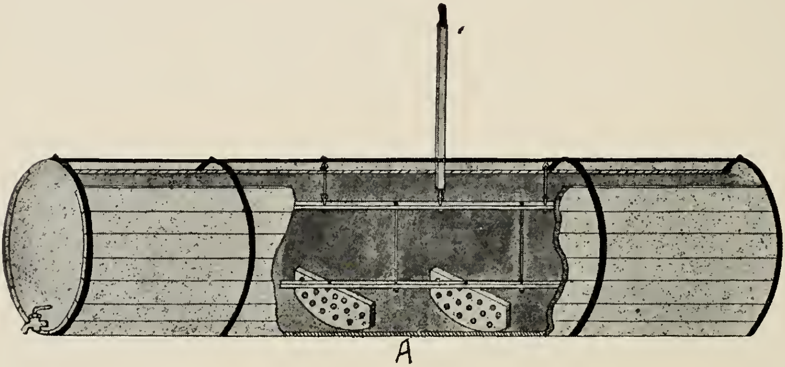

FIG. 298.—Apparatus for preparing Bordeaux mixture. Tank for receiving lime after it has been slaked and is ready to mix with the copper sulphate or bluestone. The agitator is the special feature of this tank. (Essig, P. C. Jr. Bot.)

The bluestone vat contains slats, across the entire box as shown in Fig. 299 D, or simply across one end. These slats must be low enough so that the bluestone, which is placed upon them in sacks, will be completely immersed in the water. This method admits quick dissolving of the bluestone, much more rapidly than if simply poured into the tank and stirred.

The lime and bluestone are mixed with a given amount of water so that the proper quantities of the resultant solutions can be measured so as to give the mixture the strength of the above formula.

The sieve used should be made of brass wire and contain twenty meshes to the inch.

This spray is usually used as a repellent for the flea-beetles, cucumber beetles, diabrotica, and other leaf-eating insects.

BANDS.

To prevent insects from crawling up the trunks of trees and plants various bands have been devised which have proven exceedingly successful in many instances.

Tanglefoot.—Tree tanglefoot is a thick, sticky substance which, when applied as a band, remains moist for several weeks and is a very effective barrier against cankerworms, caterpillars, cutworms, Fuller's rose beetle and other crawling insects.

The material is put up in cans. It should be applied directly to the trunk of the tree several feet above the ground.

Sticky Rope.—In the work on the California tussock moth, W. H. Volck recommends the use of rope bands saturated in an easily prepared mixture as follows:

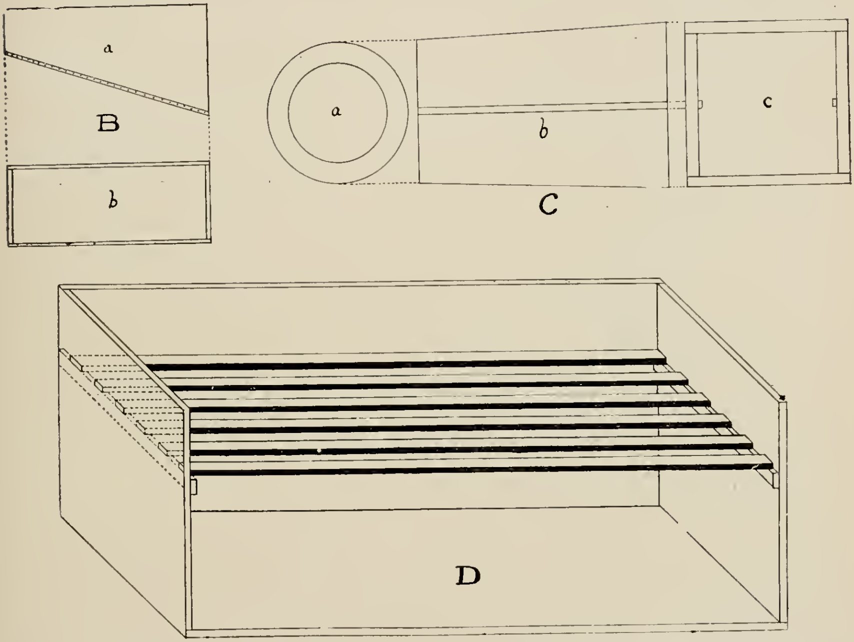

FIG. 299.—Apparatus for preparing Bordeaux mixture. B, slanting-bottom sieve for straining lime into spray tank; *a*, side view showing screen nailed to slanting bottom; *b*, top view of same; C, round wire sieve for straining lime into spray tank. *a*, round wooden bottom with hole covered with wire screen, *b*, cylindrical sides made of fine screen and tacked around the top and bottom, *c*, square frame used as a top; *d*, box for dissolving bluestone, sacks of this material being placed upon the slats and just covered with water. (Essig, P. C. Jr. Bot.)

Castor oil	1 gallon
Resin	16 pounds

(or any fraction thereof).

The resin and castor oil are gently heated until the former is completely melted. If too thick more oil may be added. The bands dipped in this mixture should be replaced by new ones about every ten days.

Crude oil rich in asphaltum or a mixture of equal parts of pine tar and molasses have also given satisfactory results.

Cotton Bands.—Bands of loose cotton fastened around the trunks of the trees are excellent in preventing the ascent of insects.

Oiled Paper.—Oiled paper tied around the trunks of small vines and plants is an old method which sometimes proves practical to-day.

WHITEWASH.

Whitewashing the limbs of trees has been an old practice of considerable merit because it serves somewhat as an insecticide and a fungicide. It also prevents sunburn.

Lately whitewash has been used with considerable success in the control of pear thrips, as follows:

Quick lime	80 pounds
Water	100 pounds

After the lime is slaked and mixed the material should be strained through a fine sieve into the spray tank.

THE APPLICATION OF SPRAYS.

EQUIPMENT.

The proper application of any spray is without doubt the most important factor in all spraying work. A very poor product well applied often gives much better results than a good product poorly applied. How much better, then, the thorough application of a reliable product.

Pumps.—The procuring of a good pump is the first step. In this the purchaser must be guided entirely by the amount of spraying he has to do. For small yards and gardens or for young orchard trees the ordinary foot and bucket pump (Fig. 300) is satisfactory. The knapsack pump (Fig. 300) is also a convenient apparatus, especially for spraying young orchard trees where there is much walking and little spraying.

For small orchards of from five to ten acres hand pumps with pressure tanks and from one to two leads of hose, such as shown in Fig. 301, do very well and give complete satisfaction if great care is taken to keep the solution in the tank well stirred and the application is made thorough. The absence of an agitator is a great handicap to any hand machine.

For orchards of from ten to twenty acres small power pumps are adequate but even in such orchards a good power machine will pay for itself in a very short time. High pressure and thorough agitation, the great essentials in spraying work, can only be had with a good power machine. Such a machine is shown in Fig. 302 and is able to supply two or four leads of hose with an adequate pressure. Orchardists owning only small orchards are clubbing together and buying a power sprayer for several orchards and find this a convenient way of getting first class work done cheaply.

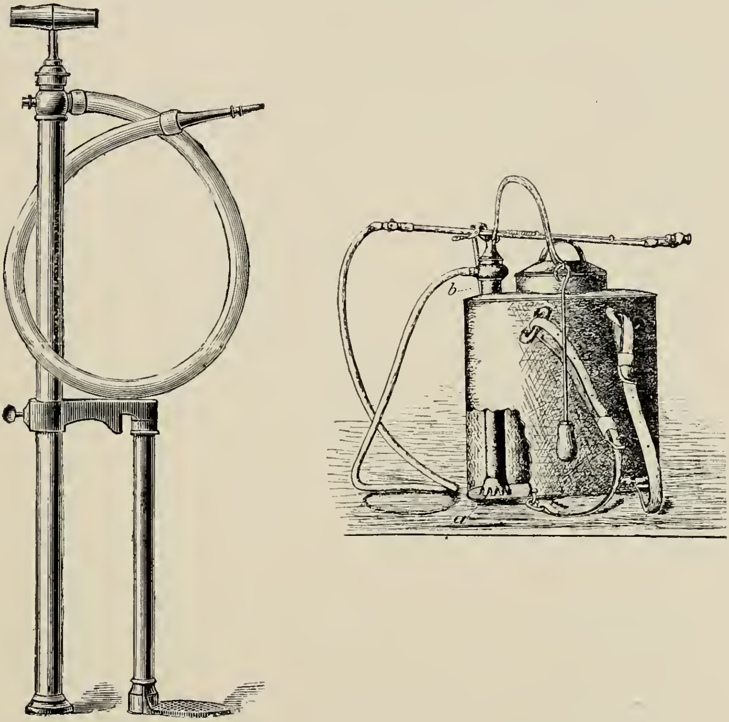

Fig. 300.—The ordinary hand, foot and bucket spray pump at left and a knapsack pump at the right. The prices of such pumps range from $2.00 to $10.00. (Cal. Hort. Com.)

For truck crops an entirely different machine has been devised. Some growers have mounted the ordinary power pumps upon a satisfactory wagon and have made attachments for spraying rows. A geared sprayer such as shown in Fig. 303 is certainly a most commendable machine, making it possible to spray rapidly, thoroughly and with little cost of operation. Such a pump is recommended for spraying potatoes, tomatoes, corn, peas or any other crops sown in rows or broadcast.

Blowers.—For the application of dust sprays, hand and power machines are manufactured. With the blower shown in Fig. 304 it is possible to cover from twenty to sixty acres in a single day, thus reducing the cost of application to almost nothing.

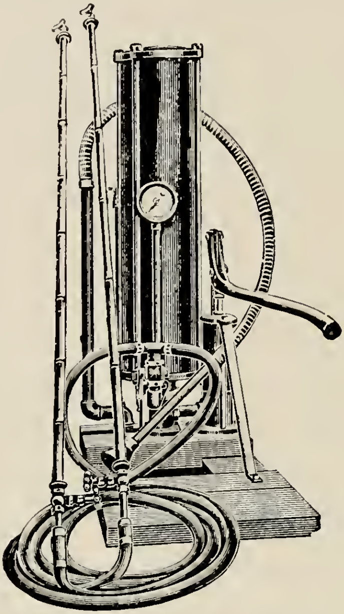

Fig. 301.—A good hand pump with pressure gauge costing from $20.00 to $25.00.

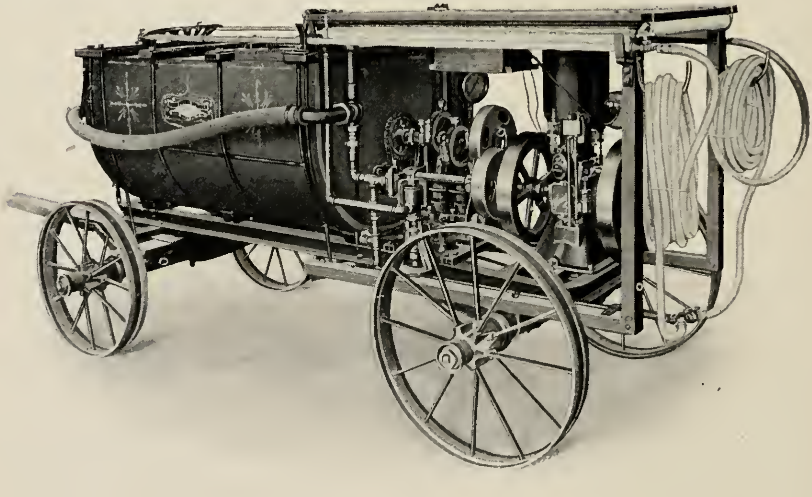

Fig. 302.—An excellent type of a power sprayer costing $350.00. (Courtesy Bean Spray Pump Co.)

Pressure.—With a good pump there will be little difficulty about maintaining sufficient pressure which is a very great consideration in obtaining good work. For general spraying the pressure should not fall below 150 pounds, while 200 pounds to the square inch is not too much. Such pressure enables the operator to reach every part of the tree or foliage in a very short time.

Nozzles.—There are at present many more types of nozzles than any one man can ever hope to test the merits of. And as a matter of fact some of the present types are adequate for all kinds of spraying work.

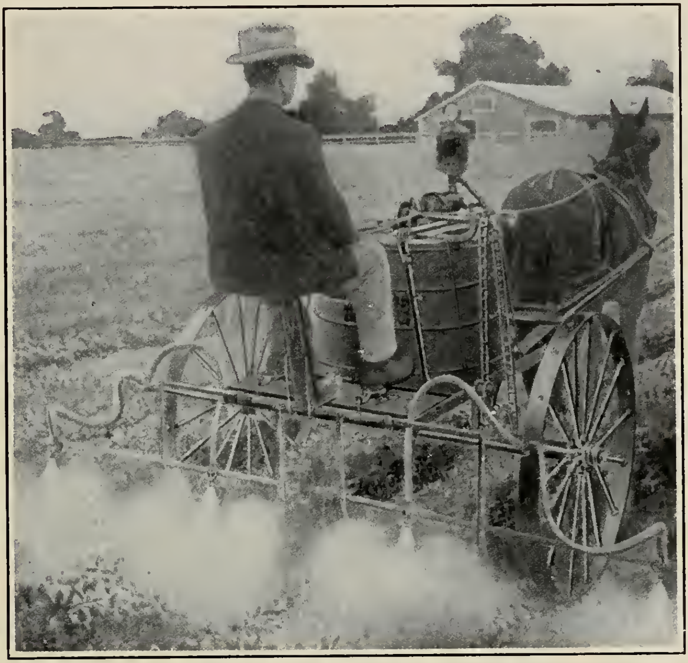

FIG. 303.—A geared sprayer which is excellent for spraying garden and truck crops. This machine costs $82.50.

The large type (Fig. 305 b and c), known as the "Jumbo," "Whirlpool," "Misty Jr." and "Friend" will meet the needs of almost any work by simply changing the disc and thus enlarging or reducing the size of the hole. For the application of very fine sprays for small animals like red spiders and mites the cyclone type as shown in Fig. 305a is very good.

It has been found that the angle nozzle (Fig. 305b) is far superior to the straight form in that it admits of a much greater range of work allowing the operator to spray up, down or straight into the tree by a simple turn of the wrist.

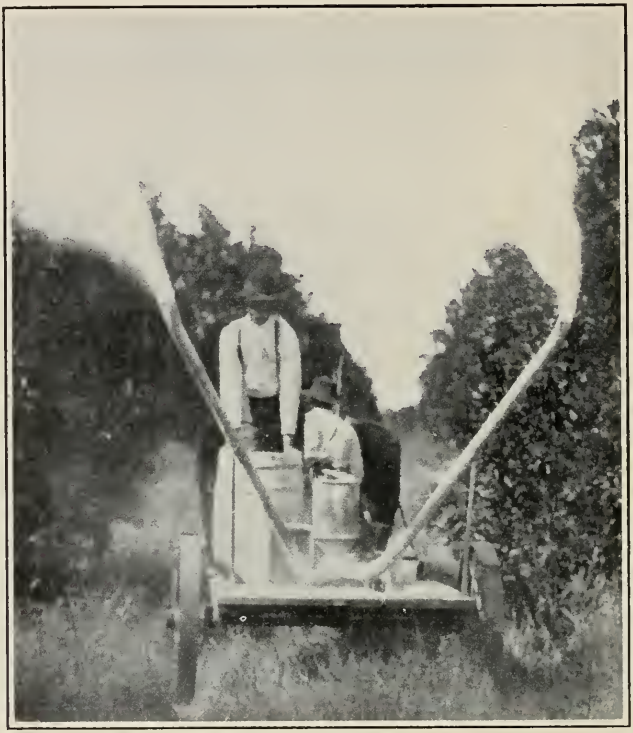

Fig. 304.—A power blower for applying dust sprays in orchards. About forty acres can be treated in one day with such a machine. It costs $115.00.

For a power pump and two leads of hose, two angle nozzles (Fig. 305 a or b) on a straight "Y" (Fig. 306) or two straight nozzles (Fig. 305c) on an angle "Y" (Fig. 306) to each lead of hose have given the most satisfactory results in the thoroughness, quickness and cheapness of application.

THOROUGHNESS.

Great care should be taken to make the application thorough in every respect. The material should not only be well agitated but applied to every portion of the tree. Most of the unsatisfactory results in spraying are due to inefficient and careless operators. Every portion of the tree should be thoroughly drenched. The tips of the side branches and the tops should receive the same careful consideration as is usually given to the trunk. No one can hope for good results who neglects this important phase of spraying work.

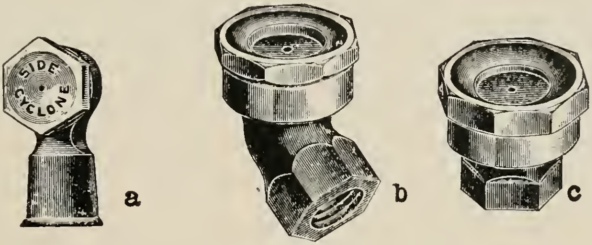

Fig. 305.—Spray nozzles. a, side cyclone, a splendid nozzle for spraying trees and plants infested with red spiders or mites; b, angle and c, straight "Jumbo" nozzles, excellent for general work.

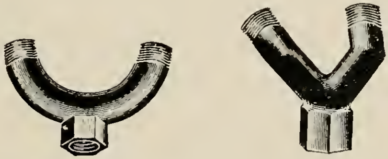

Fig. 306.—Straight and angle "Y." The "U" shaped form is much better than one with a "V" shaped fork as shown at the right, because the spray is forced straight ahead instead of sideways. Angle nozzles should be used on the straight "Y" and straight nozzles on the angle "Y."

TIME OF APPLICATION.

Of course the time of application varies somewhat with each particular pest, but there is a time for every one. The grower should carefully ascertain when that time is and do the work then and not wait until his efforts bring little or no avail. Those who spray for codling moth can appreciate what the time element means.

APPROXIMATE COST OF SPRAYING MATERIALS.

The following prices have been secured from a large number of dealers and represent the average retail cost of these materials. Such prices, though exceedingly variable, enable the grower to arrive at the approximate cost of a spray and also show that it is desirable to buy in as large quantities as possible.

Commercial Lime-Sulphur Solution.

In lots of from 1 to 25 barrels	$10 00 per barrel.
In lots of 20 barrels	9 00 per barrel.
In lots of 100 barrels	8 00 per barrel.

There is an extra charge of from $1.00 to $1.50 on each barrel which if returned is refunded.

These prices are f. o. b. at point of destination.

Copper Sulphate (bluestone).

The price of this commodity is exceedingly variable but at present is as follows:

In 5 or 25 pound lots	25 cents per pound.
In 100 pound lots	9 cents per pound.
In 450 pound lots	7½ cents per pound.
In 2000 pound lots	7 cents per pound.
In car load lots	6 cents per pound.

Arsenate of Lead (paste 15 per cent).

In 5 pound steel containers	13½ cents per pound.
In 10 pound steel containers	12¾ cents per pound.
In 25 pound steel containers	12 cents per pound.
In 50 pound steel containers	10½ cents per pound.
In 100 pound steel containers	10 cents per pound.

Arsenate of Lead (dry).

In 1 pound lots	32 cents per pound.
In 5 or 10 pound lots	30 cents per pound.
In 50 pound lots	26 cents per pound.

In ton lots these prices are reduced 10 per cent.

Arsenite of Zinc (powder).

½ or 2 pound cartons	20 cents per pound.
48 pound cartons	18 cents per pound.

Paris Green.

1 pound lots	30 cents per pound.
5 or 10 pound lots	27 cents per pound.
50 or 100 pound lots	25 cents per pound.

Lime (unslaked).

In 5 to 25 pound lots	2 cents per pound.
In 100 pound lots	$1 15 per 100 pounds.
In barrels of 220 pounds	$1 50 to $1 85 each.

Sulphur (flowers or resublimed).

In 5 pound lots	4 cents per pound.
In 25 pound lots	3½ cents per pound.
In 100 pound lots	2¾ cents per pound.
In 500 pound lots	$2 65 per 100 pounds.
In ton lots	2 50 per 100 pounds.

Caustic Soda (powdered, 98 per cent).

In 5 pound lots	5½ cents per pound.
In 25 pound lots	5 cents per pound.
In 100 pound lots	4½ cents per pound.
In 500 pound lots	4 cents per pound.
In ton lots	3½ cents per pound.

Whale Oil Soap.

In 5 pound lots	10 cents per pound.
In 25 pound lots	7¾ cents per pound.
In 40 to 45 pound lots	4 cents per pound.

Tobacco Extract (40 per cent).

1 gallon cans	$ 1 15 per gallon.
5 gallon cans	90 per gallon.
10½ gallon cans	12 00

Crude Carbolic Acid (15 to 20 per cent phenols).

In 1 pound lots	25 cents per pound.
In 5 pound lots	23 cents per pound.
In 25 pound lots	22 cents per pound.
In 50 pound lots	20 cents per pound.

Resin.

In 5 pound lots	5 cents per pound.
In 25 pound lots	4½ cents per pound.
In 100 pound lots	4 cents per pound.
In 500 pound lots	$3 85 per 100 pounds.
In ton lots	3 75 per 100 pounds.

Kerosene (cheap grade).

In 1 to 5 gallon lots	15 cents per gallon.
In 25 gallon lots	13½ cents per gallon.
In 50 gallon lots	12 cents per gallon.

Distillate (28 degrees Baumé).

In 1 gallon lots	10 cents per gallon.
In 5 gallon lots	8 cents per gallon.
In 25 gallon lots	7 cents per gallon.
In 50 gallon lots	6 cents per gallon.

Containers extra.

Crude oil may be purchased at from 3 to 5 cents a gallon.

Pyrethrum (powdered).

In 1 pound lots	36 cents per pound.
In 5 pound lots	34 cents per pound.
In 10 pound lots	32 cents per pound.
In 50 pound lots	30 cents per pound.

CALIFORNIA SPRAY CHEMICAL COMPANIES.

Balfour Guthrie Company, San Francisco, California.
Bean Spray Pump Company, San José, California.
Braun Corporation, Los Angeles, California.
Braun-Knecht-Heimann, San Francisco, California.
California Drug and Chemical Company, Los Angeles, California.
California Rex Spray Company, Benicia, California.
California Spray-Chemical Company, Watsonville, California.
Fruit Growers' Supply Company, Los Angeles, California.
Haas, Baruch & Company, Los Angeles, California.
Kirk-Geary, Sacramento, California.
Mountain Copper Company, San Francisco, California.
Monarch Oil Refining Company, San Francisco, California.
The American Agricultural Chemical Company, Los Angeles, Cal.

CALIFORNIA SPRAYING MACHINE COMPANIES.

Baker & Hamilton, San Francisco, California.
Bean Spray Pump Company, San José, California.
Crane Company, San Francisco, California.
Household Supply Company, San Francisco, California.
Smith-Booth-Usher, Los Angeles, California.
Theo. Poindexter, San Francisco, California.

*FUMIGATION.

Fumigation consists in the generation and uses of gases to kill destructive insect pests. Formerly such practices were limited to the uses of carbon bisulfid, sulphur dioxid and tobacco fumes. The use of hydrocyanic acid gas in citrus orchards has lately been so perfected as to become of very great importance and has opened up a remarkable field in the control of orchard pests.

CARBON BISULFID.

Carbon bisulfid is a liquid which evaporates into a heavy, highly explosive gas. It was first used for fumigating beans, grains or cereals for weevils, and is still a very efficient method of controlling such pests. In handling the liquid great care should be taken to keep it away from a flame on account of its being highly explosive.

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*For further information relative to fumigation, see
Bull. No. 76, Bur. Ent., U. S. Dept. Agrcl., by A. W. Morrill.
Bull. No. 79, Bur. Ent., U. S. Dept. Agrcl., by R. S. Woglum.
Bull. No. 90, (Part I.) Bur. Ent., U. S. Dept. Agrcl., by R. S. Woglum.
Bull. No. 90, (Part II.) Bur. Ent., U. S. Dept. Agrcl., by R. S. Woglum.
Bull. 152, Cal. Agrcl. Exp. Sta., by C. W. Woodworth.
Circular No. 11, Cal. Agrcl. Exp. Sta., by C. W. Woodworth.
Circular No. 50, Cal. Agrcl. Exp. Sta., by C. W. Woodworth.

For Storehouse Pests.—Before fumigation is begun care should be taken to see that the room or container is made as tight as possible. The temperature should be 70 deg. Fahr. or above, as poor and unsatisfactory results are sure to follow even excessive doses at a lower temperature. In a tight compartment five pounds to every thousand cubic feet gives excellent results in killing weevils. If the compartments cannot be made tight, increase the amount of carbon bisulfid.

For Root Pests.—In the field this liquid is used to kill root pests as woolly aphis, black peach aphis, phylloxera, grubs, maggots, etc., but is practical only in sandy or porous soils. For a small plant a single hole is made near the base and a teaspoonful of the liquid poured in and the hole covered to prevent outside evaporation. For larger plants several or many holes should be made, deep enough to allow the liquid to evaporate around the infested roots. A syringe-like instrument is sometimes used to inject the liquid around the roots.

For Borers.—Injections of carbon bisulfid into the burrows of wood borers and stopping the entrance of the burrows will kill all the insects reached by the gas.

For Ants and Wasp Nests.—A small amount of this liquid poured into underground nests of ants, wasps, etc., will suffice to destroy the inhabitants very quickly.

TOBACCO FUMES.

For very tender house and greenhouse plants infested with plant lice, thrips, etc., it is sometimes advisable to fumigate them with slowly burning tobacco, but even in such cases hydrocyanic acid gas is replacing the more uncertain tobacco fumes.

HYDROCYANIC ACID GAS.

Hydrocyanic acid gas is generated by the addition of diluted sulphuric acid to sodium or potassium cyanide. The generation is made in an earthenware jar, the gas being confined in a fumigation house or, if the work is being done in the orchard, in a tent thrown over the tree. For many years the methods of fumigation depended entirely upon each fumigator, there being no uniform or common procedure. The results of this early work so clearly showed the need of systematism that the United States Department of Agriculture set experts to work out a reliable and uniform system of procedure. Dr. A. W. Morrill inaugurated our present system of marked tents and a system of dosage, which is known as "The Morrill System." This work was done in Florida. Later Mr. R. S. Woglum began operations in California and greatly perfected this system so as to make it at once practical and available to all the orchardists.

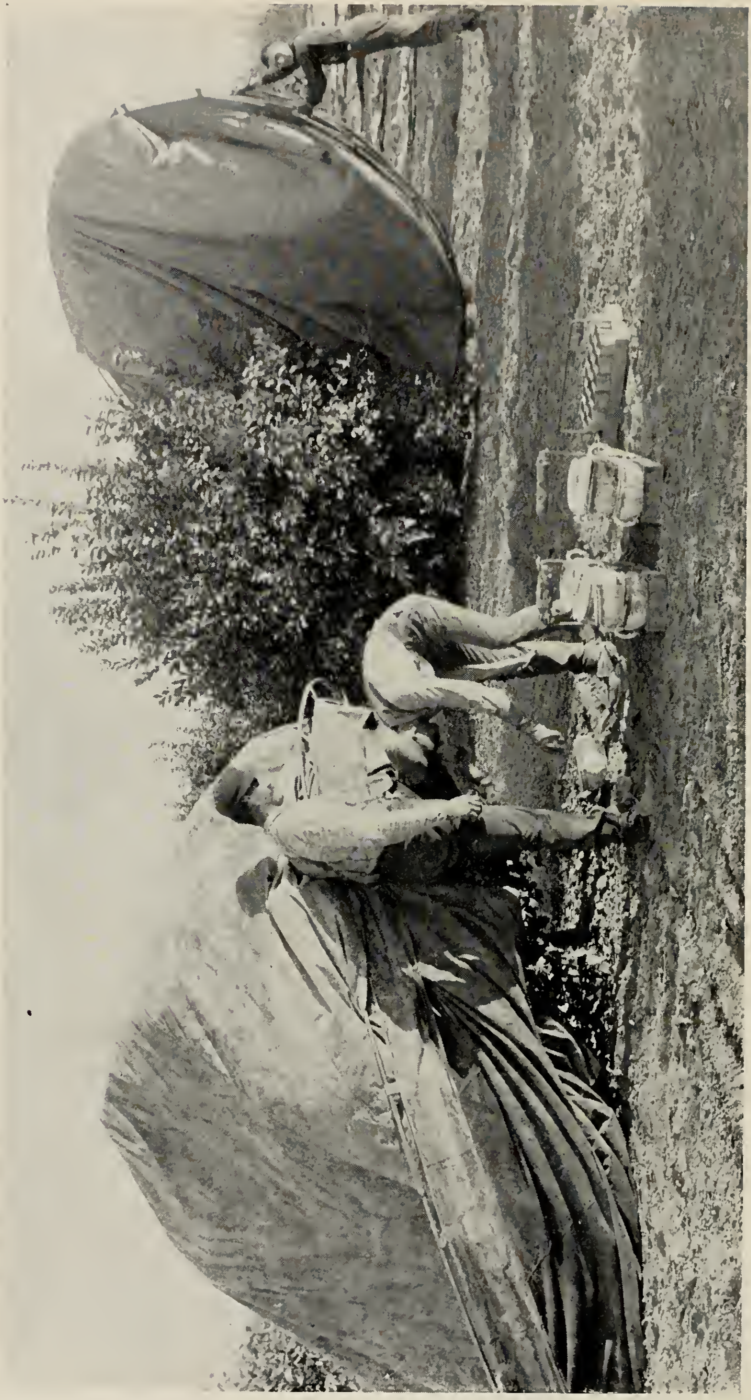
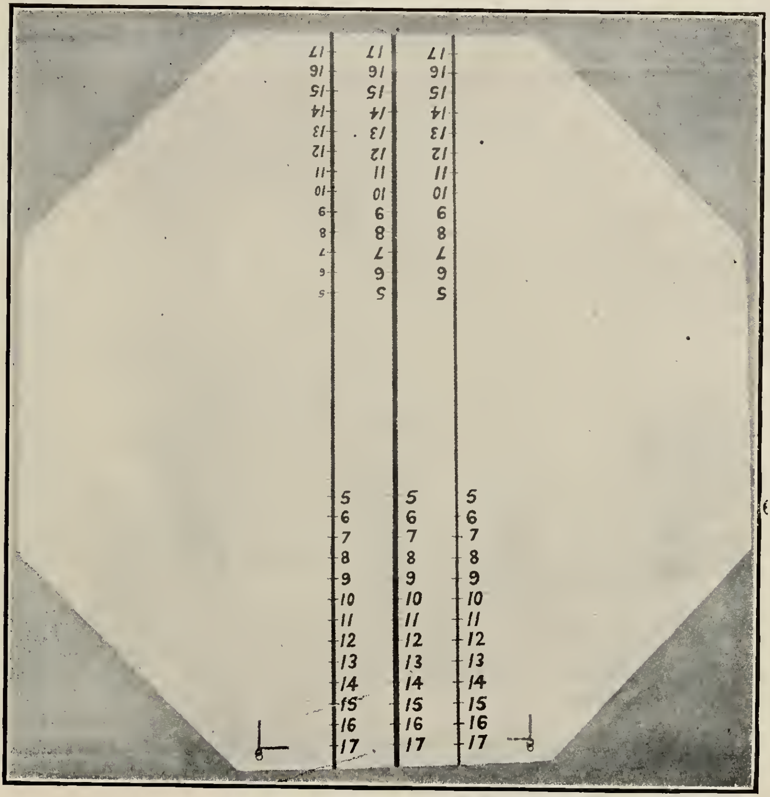


Fig. 307.—Bell tents and old method of dosing. (Cal. Hort. Com.)

TENTS.

Shape.—In order to conform as near as practicable to the form of a tree, fumigation tents are made in the shape of an octagon (8-sided) (Fig. 308). If the tents were square the corners would be a constant and unnecessary annoyance.

For small trees bell tents (Fig. 307) were formerly made by cutting the tents circular and sewing a strong hoop around the bottom. Such tents are seldom if ever used at the present time.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17 16 15 14 13 12 11 10 9 8 7 6 5
5 6 7 8 9 10 11 12 13 14 15 16 17
5 6 7 8 9 10 11 12 13 14 15 16 17
5 6 7 8 9 10 11 12 13 14 15 16 17

FIG. 308.—Showing shape and method of marking tent. (U. S. Dept. Agrcl.)

Size.—The size of a tent naturally depends upon the size of the tree. For young orchards a twenty-foot tent will serve until the trees are about four years old and the tents can then be enlarged by simply sewing a border around the edges. This border might just as well be made of lighter and less expensive materials. In this way an orchard may be carried over until the ordinary orchard tents can be used. In fact many fumigators do use a large tent upon a small tree by placing a suitable square or triangular frame around the tree to support the tent or if the trees are strong enough to allow them to support the tents unaided (Fig. 320).

For ordinary work forty-five-foot tents are commonly used and meet all requirements of a full grown orchard, except for unusually large trees, many of which require seventy or eighty-foot tents. It is customary, however, to use two or even three tents together when there is only an occasional large tree.

Materials.—The life and nature of a fumigation outfit depends upon the quality and care of the tents. Many materials have been recommended and tried; army duck and drills of various weights being those most used. Special tight-woven drill tents were recommended by fumigating investigators, but these materials, though allowing but a small escape of gas, have not been able to stand the rough usage. After several years of trial with the drills it is becoming the unanimous opinion of fumigators that by far the best all around tent material is the eight-ounce army duck. Though somewhat coarse and open it is able to hold the gas well and may be used almost twice as long as the drills.

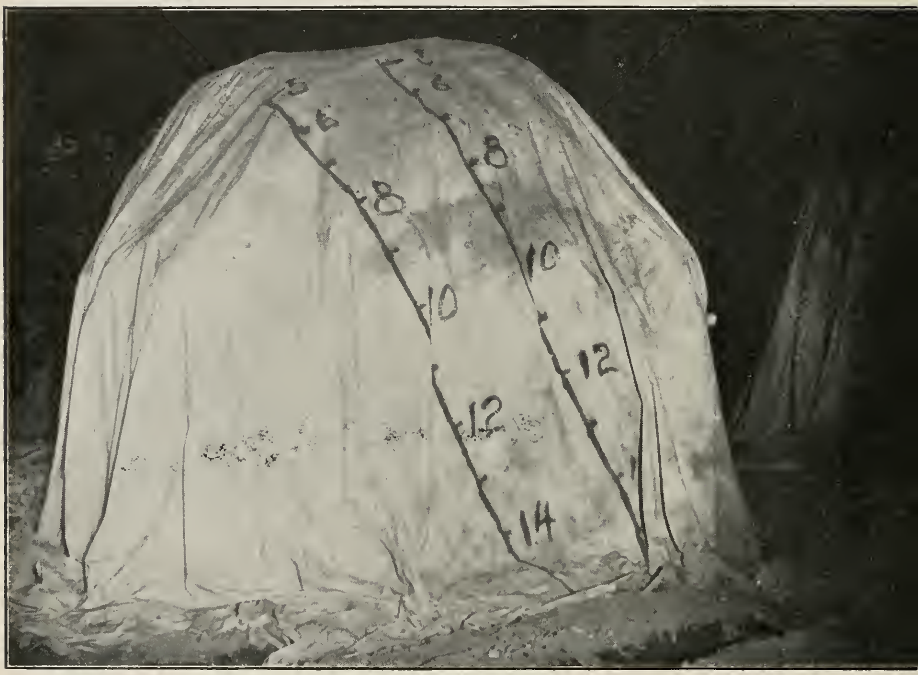


Fig. 309.—Marked fumigating tent over tree. (After Pierce, P. C. Jr. Ent.)

Tents should be ordered a little larger to allow for shrinkage when dipped.

Dipping.—To prevent moulding and rotting, new tents are usually treated in a tannin bath. A suitable outfit for this work is shown in Fig. 310.

The tank should have a capacity of from two hundred and fifty to three hundred gallons. Oakbark extract of tannin is used at the rate of one pound to every five gallons of water. Six or eight pounds of tannin and the amount of water removed with the tent should be added after each is dipped.

The tannin solution should be brought to a boil and the tents immersed for half an hour after which they are removed and spread out to dry.

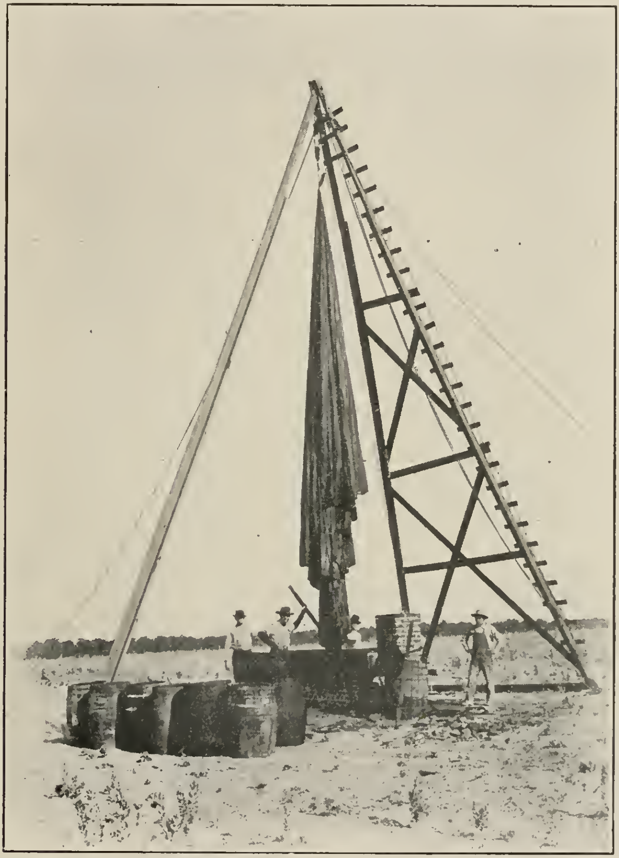


FIG. 310.—Apparatus for dipping tents in tannin to prevent mildew. (After Woglum.)

A forty-five-foot tent will shrink about one foot all around in dipping (allowing for some stretching by use afterwards).

The cost of dipping for tannin, fuel, labor, etc., amounts to about $1.20 to $1.50 outside of equipment.

The writer is indebted to Mr. R. S. Vaile, horticultural commissioner of Ventura County, for the information on shrinkage and cost of work.

Marking.—Because of the shrinkage it is preferable to mark the tents after dipping.

The usual practice consists in marking three one and a half or two-inch parallel lines across the tent three feet apart. Three lines are made in preference to one, so that when the tent is put over the tree one of these lines wlll be sure to pass over the center. The measurements over the tree are ascertained by numbering each foot across the tent, beginning in the middle, and numbering each way, as shown in Fig. 308. The first four numbers are not designated because they are seldom if ever used. The cost of marking and stenciling the numbers averages about seventy-five cents a tent.

Number for Outfit.—The ordinary fumigating outfit consists of from thirty to forty tents, a number which five men are capable of throwing and dosing at hourly intervals. An increase in apparatus or men for handling and dosing will naturally admit of an increase in this number.

Care.—Greatest care should be exercised to prevent acid coming in contact with the tents for every contact results in a large or small hole. Every day each tent should be carefully examined and all holes covered with sewed patches. Failure to follow these suggestions means poor and unsatisfactory work.

CHEMICAL WAGONS.

Under the old system of scheduling and estimating, the dosage for every tree was made up at some central point in the orchard and distributed in carriers by hand (Fig. 319). The new system of determining and making the dosage of every tree separately gave rise to the chemical cart or wagon, which carries a full supply of acid, cyanide and water in easily available shape.

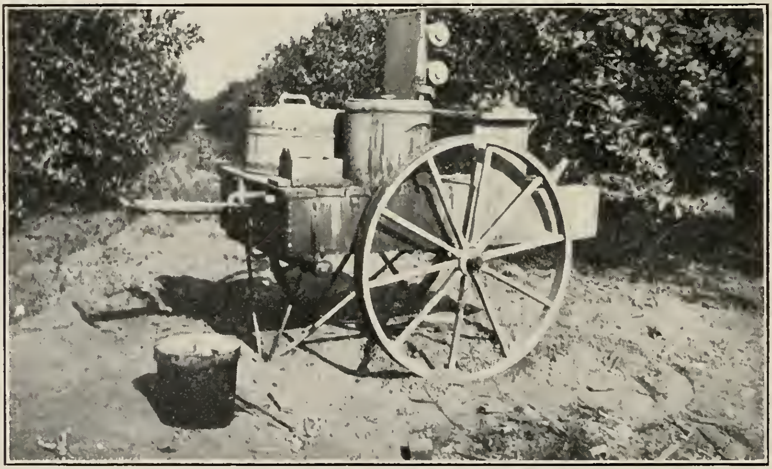


Fig. 311.—A cheap and satisfactory hand chemical cart. (Photo by Vaile.)

The sulphuric acid should be kept in an earthenware or lead-lined container and drawn off through a rubber siphon or outlet. An ordinary keg or barrel with faucet will hold the water and a tight box is all that is necessary for the cyanide. Dosage schedules, graduates, clamps, rubber gloves, scales and sufficient light complete the outfit. (Figs. 311, 312, 313.)

Acid Container.—For ordinary work a three, five or ten-gallon earthenware jar is sufficient. A lead lid for the top and a three fourths inch iron pipe inserted through a hole in the side near the bottom with a piece of pure rubber tubing six inches long and closed by an acid clamp is a cheap and practical device. Lead-lined tanks are more durable, but also much more expensive.

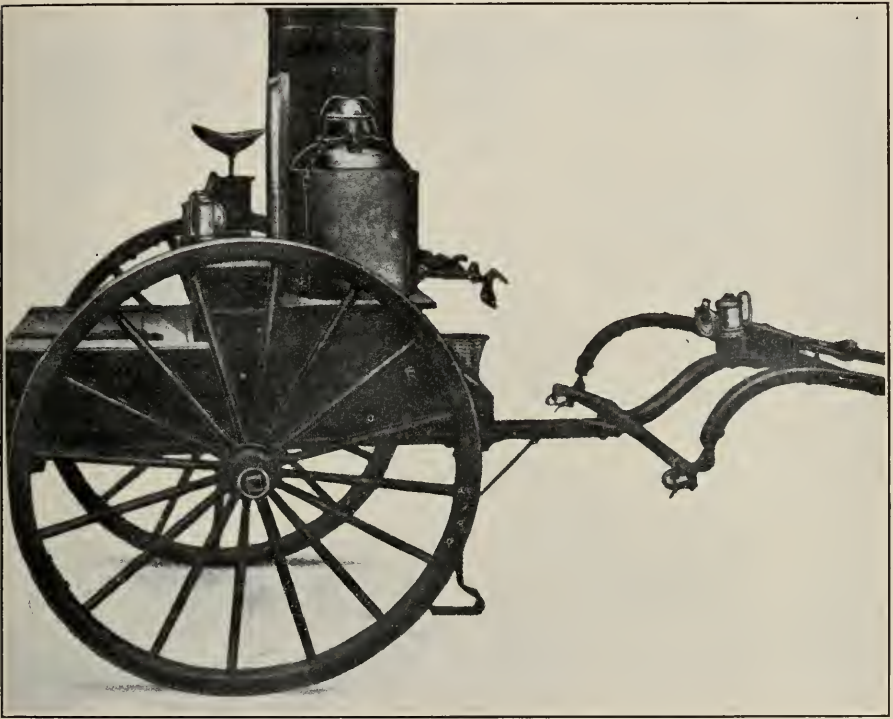


FIG. 312.—A splendid but expensive chemical cart. (After The Braun Corporation.)

Water Tank.—As there is three times as much water used as acid the water tank must necessarily be larger. For a hand cart a pickle keg is excellent, while a twenty-five or fifty-gallon barrel may be necessary for a large wagon. An extension pipe and faucet furnish the outlet which should be near that of the acid tank.

Graduates.—The quantity of acid and water used depends entirely upon the amount of cyanide required for a dose. For every ounce of potassium cyanide one fluid ounce of sulphuric acid and three fluid ounces of water are used, while for sodium cyanide one and a half liquid ounces of sulphuric acid and two liquid ounces of water are used. As this is a fixed ratio in each case, graduates have been made to measure out the exact amount of the liquid required in the terms of the number of ounces of cyanide; for instance if it required twelve ounces of sodium cyanide for a dose the acid graduate is so scaled that it would be filled to the twelve ounce line, which would mean eighteen liquid ounces and the water graduate to the twelve-ounce line, which would be twenty-four liquid ounces. Such a scheme makes it unnecessary to make mental calculations and thus avoids mistakes.

ACID GENERATORS.

Acid generators are earthenware pots usually made in gallon, two-gallon and three-gallon sizes and with or without lids (Fig. 314). The lid has long been recognized as a valuable adjunct to a generator by throwing the gas outward, thus preventing burnings directly above the generator. It also prevents the sputtering over of the acid due to the violent chemical reaction when the cyanide is added. So far there appears to be no lid manufactured which is entirely satisfactory, though nearly all fumigators prefer those on the market to the open generator. A suitable lid should be light and hinged so as to admit of easy emptying.

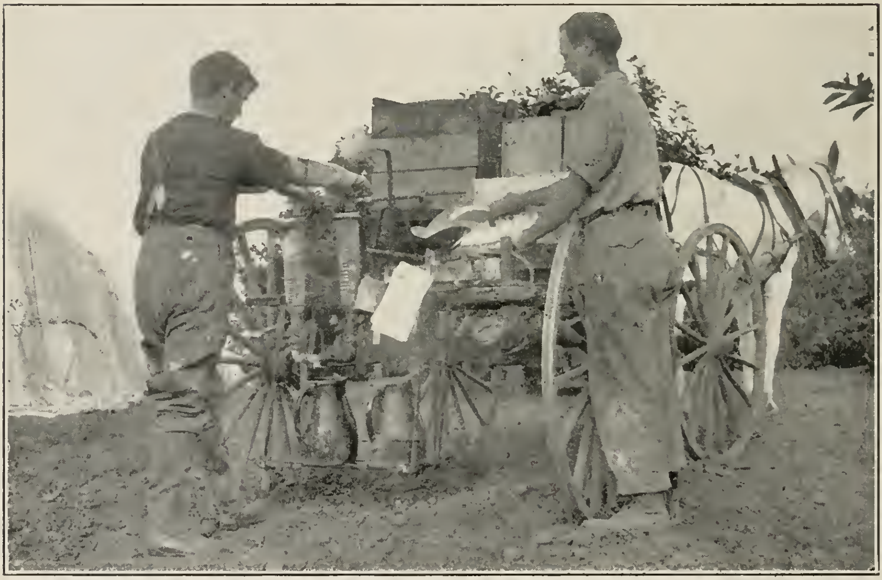


FIG. 313.—A specially constructed chemical wagon. (Photo by Fawcett.)

The two-gallon generator is more generally used because it more nearly meets the requirements of large and small doses. Care should be exercised not to fill a single pot more than one third full of acid and water before the cyanide is added as the contents may boil over and much of it be wasted. For large doses use two or more generators to a tree. To prevent unnecessary sputtering, especially when open generators are used, small cheap paper bags are excellent to contain the cyanide when it is dropped into the acid.

MEASURING THE TENTS.

The air space of the tents is determined by a schedule based upon the cubical contents which in actual field operations is determined by the distances over and around the tent when it covers a tree. The distance over is easily ascertained by the marked lines across the tent—the sum of the two figures nearest the ground being taken. The distance around is often paced, but careful fumigators use a tapeline which is certainly the only procedure to be recommended. The tapeline should be numbered in feet on both sides, the numbering of each side being opposite so as to admit of the use of either end without subtraction. A small, light snap is usually sewed to each end to be fastened to the ring at the top of a short iron pin stuck in the ground to hold the loose end while the tape is carried around the tent.

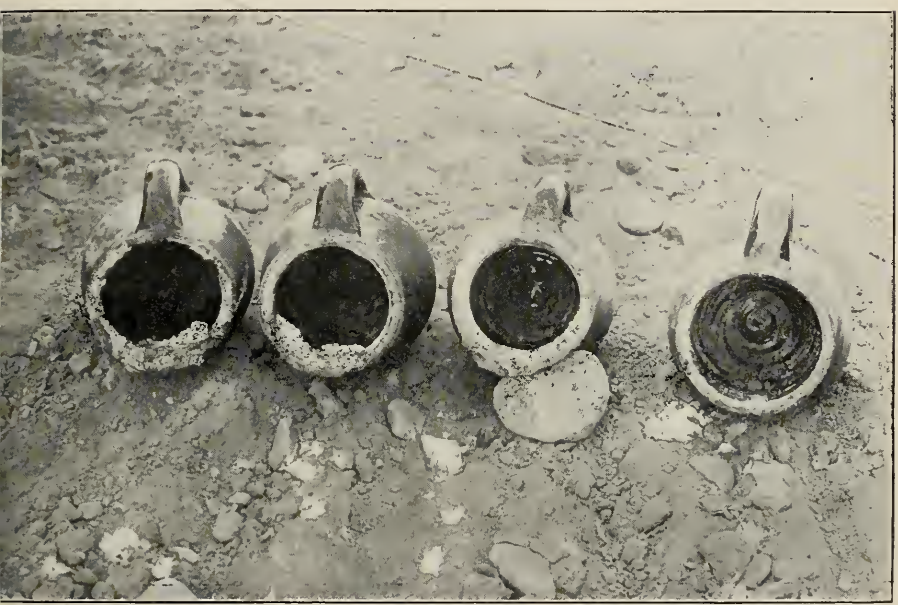


FIG. 314.—Acid generators showing residue remaining because of careless emptying. (After Pierce, P. C. Jr. Ent.)

DOSAGE SCHEDULES.

These schedules are printed on fairly stiff paper so that they may be tacked upon a board for the use of the cyanide man. The figures are black and large enough to be plainly seen by the light of a torch or lantern on the darkest night. Half and quarter ounces are omitted, because of the difficulty in reading the small fractions at night and because few scales are made to register these small amounts accurately. All less than half ounces are placed in the lower figure, while half ounces or over are placed in the next higher figure. A more convenient way of fixing up the schedule is to have a cylinder made of zinc, with a narrow slot, the width of a row of figures, covered by a glass, and a wooden roller on the inside, similar to a rolling pin. Each end of the cylinder is closed by a cap with a hole in the center, in which turns the handles of the wooden roller. The chart or schedule is attached to the roller so as to revolve in the cylinder. The figures of the distances around are pasted along the top of the slot to conform with the like numbers on the schedule. In finding the dosage one has only to turn the roller until the distance over shows at the left-hand end of the slot, the figure at the top of the slot shows the distance around. In this way, the chart is kept perfectly dry and bright and the possibilities of making a mistake are reduced to a minimum. This arrangement was first invented by Mr. McFadden, who uses it on all of his chemical carts.

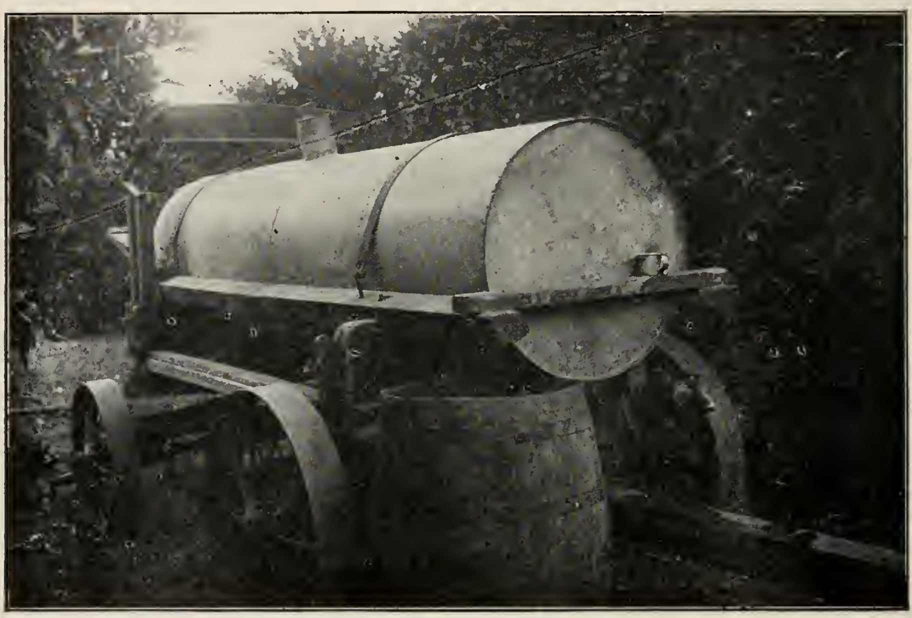


FIG. 315.—A water supply wagon for a large fumigating outfit. (After Pierce, P. C. Jr. Ent.)

MISCELLANEOUS EQUIPMENT.

Rubber gloves for handling the acid graduate and generators, pure rubber tubing for drawing off the acid, acid clamps or cut-offs to control the flow, a pair of scales registering ounces, thermometer and good lights are as necessary as any of the other equipment.

CHEMICALS.

The chemicals used for generating hydrocyanic acid gas in fumigating work are potassium or sodium cyanide, commercial sulphuric acid and water. The cyanide is usually handled in the 200-pound cases and the acid in steel drums weighing from 1,200 to 2,000 pounds.

Cyanide.—For many years potassium cyanide 98-99 per cent pure was thought to be the best and only reliable source of hydrocyanic acid gas. It was formerly used to the exclusion of all others and is still preferred by many who do not wish to add the injurious residue of sodium cyanide to their soil, and also by those who do not see enough advantages in sodium cyanide to warrant a change.

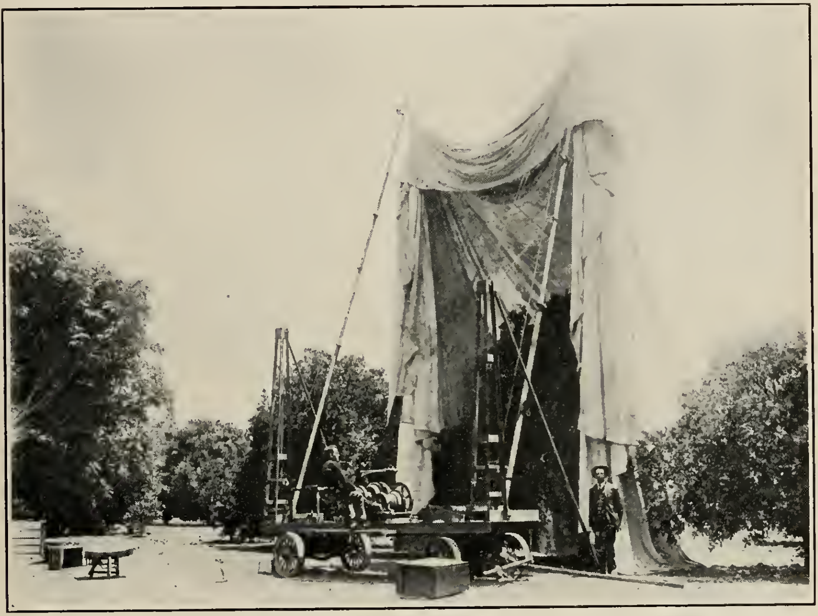


FIG. 316.—The McFadden tent-hoisting machine. (After Woglum.)

There are two grades of sodium cyanide; the 98-100 per cent pure, which is totally unfit for fumigation purposes because of the impurities it contains, and the pure 129-130 per cent sodium cyanide, which is used almost exclusively for fumigation work. This product, though somewhat more expensive than the potassium cyanide per pound, has much more available hydrocyanic acid gas and consequently a smaller amount is necessary, which is enough smaller to make the cost of dosage less than that for potassium cyanide, and is therefore fast displacing it. Much has been said for and against the sodium cyanide relative to the burning of fruit and foliage, but this is still an unsettled point.

Both of the cyanides are good and reliable, and the deciding features will probably always be the supply available and the price.

Sulphuric Acid.—Fumigating sulphuric acid has a specific gravity of about 66 degrees Baumé and often containing traces of nitric acid and arsenic, lead or zinc. It has been the current belief that especially nitric acid caused the burning of the fruit and foliage so often the results of fumigating work, but R. S. Woglum in Bull. No. 90, Part I, page 42, U. S. Dept. Agrcl. Bureau, Entomology, states that this is an erroneous belief. It should always be the aim of every fruit grower to get good grades of sulphuric acid, which is not at all difficult at the present time.

CHEMICAL PROPORTIONS.

Potassium Cyanide:

Potassium cyanide	1	ounce.
Sulphuric acid	1	fluid ounce.
Water	3	fluid ounces.

Sodium Cyanide:

Sodium cyanide	1	ounce.
Sulphuric acid	1½	fluid ounces.
Water	2	fluid ounces.

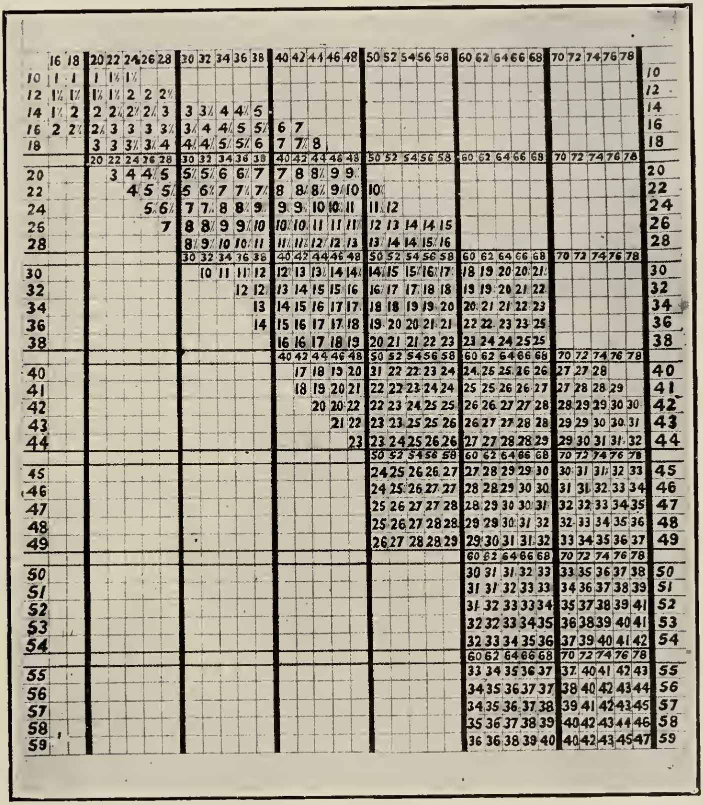
METHODS OF PROCEDURE.

For an outfit of thirty or thirty-five tents five men are required to operate to an advantage. Two men pull the tents and kick in the edges around the bottom. One man, the taper, takes the measurements of the tree and calls them off to the man who weighs out the cyanide. After determining the dosage this man also empties the generators from the row just finished and has them ready for the next trees by the time the chemical cart arrives. The man who weighs the cyanide determines the dose on the schedule from the measurements called out by the man who measures the tents. The cyanide man also lifts the tent so that the last man who measures out the acid and water in the generators may place them well under the tree, after which the cyanide is added. In no case should the acid man touch the tents. While the chemical men are dosing one tree the taper is getting the measurements for the next tree ready in advance. In brief, the procedure is as follows: putting the tents over the trees, measuring and dosing. The string of thirty tents can be easily dosed within forty-five minutes or an hour. Methods of procedure vary considerably, the above being general.

For extra large trees a special tent-hoisting apparatus (Fig. 316) has been devised by Mr. C. E. McFadden, with which a 70 or 80-foot tent can be easily and quickly put over the largest citrus trees.

DOSAGE.

The amount of cyanide used depends upon the pest to be treated. Accordingly several schedules (Figs. 317, 318) have been made, based upon dosage schedule No. 1 for purple or red scale made by R. S. Woglum. This dosage consists of one and a half ounces of potassium cyanide to every one hundred cubic feet of air space. The schedule dosage for black scale usually consists of three fourths of schedule No. 1 and is designated dosage schedule No. ¾.



Distance around tree.

Distance over tree.

	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
10	1	1	1	1½	1½												
12	1½	1½	1½	1½	2	2	2½										
14	1½	2	2	2½	2½	2½	3	3	3½	4	4½	5					
16	2	2½	2½	3	3	3	3½	3½	4	4½	5	5½	6	7			
18			3	3	3½	3½	4	4½	4½	5½	5½	6	7	7½	8		
20				3	4	4½	5	5½	5½	6	6½	7	7	8	8½	9	9½
22					4	5	5½	6	6½	7	7½	7½	8	8½	8½	9½	10
24						5½	6½	7	7½	8	8½	9	9	9½	10	10½	11
26							7	8	8½	9	9½	10	10½	10½	11	11	11½
28								8½	9½	10	10½	11	11½	11½	12	12	13
30									10	11	11½	12	12½	13	13½	14	14½
32											12	12½	13	14	15	15½	16
34												13	14	15	16	17	17½
36												14	15	16	17	17	18
38													16	16	17	18	19
40														17	18	19	20
41														18	19	20	21
42															20	20	22
43																21	22
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	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	
10																10
12																12
14																14
16																16
18																18
20																20
22	10½															22
24	11½	12														24
26	12	13	14	14	15											26
28	13½	14	14	15½	16											28
30	14½	15	15½	16½	17	18	19	20	20	21½						30
32	16½	17	17	18	18	19	19	20	21	22						32
34	18	18	19	19	20	20	21	21	22	23						34
36	19	20	20	21	21	22	22	23	23	25						36
38	20	21	21	22	23	23	24	24	25	25						38
40	31	22	22	23	24	24	25	25	26	26	27	27	28			40
41	22	22	23	24	24	25	25	26	26	27	27	28	28	29		41
42	22	23	24	25	25	26	26	27	27	28	28	29	29	30	30	42
43	23	23	25	25	26	26	27	27	28	28	29	29	30	30	31	43
44	23	24	25	26	26	27	27	28	28	29	29	30	31	31½	32	44
45	24	25	26	26	27	27	28	29	29	30	30	31	31½	32	33	45
46	24	25	26	27	27	28	28	29	30	30	31	31	32	33	34	46
47	25	26	27	27	28	28	29	30	30	31	32	32	33	34	35	47
48	25	26	27	28	28	29	29	30	31	32	32	33	34	35	36	48
49	26	27	28	28	29	29	30	31	31	32	33	34	35	36	37	49
50						30	31	31	32	33	33	35	36	37	38	50
51						31	31	32	33	33	34	36	37	38	39	51
52						31	32	33	33	34	35	37	38	39	41	52
53						32	32	33	34	35	36	38	39	40	41	53
54						32	33	34	35	36	37	39	40	41	42	54
55						33	34	35	36	37	37	40	41	42	43	55
56						34	35	36	37	37	38	40	42	43	44	56
57						34	35	36	37	38	39	41	42	43	45	57
58						35	36	37	38	39	40	42	43	44	46	58
59						36	36	38	39	40	40	42	43	45	47	59

FIG. 317.—Schedule No. 1. The first few dosages should be doubled. (U. S. Dept. Agrcl.)

If sodium cyanide is used the dosages are reduced 25 per cent.

Black Scale.—Either dosage schedule No. ¾ or ½ for potassium cyanide or ½ for sodium cyanide. The smaller dosage is recommended only where there is an even hatch of very young scale insects.

Purple, Red, Yellow Scale.—Use dosage schedule No. 1 for potassium cyanide and No. ¾ for sodium cyanide.

Mealy Bug.—The same dosage as for black scale gives almost as good results as the heavier doses.

LENGTH OF EXPOSURE.

The time required to complete the generation of the gas is not long, but it is advisable to leave the tents upon the trees for at least forty-five minutes after the dosage is placed under the tent. Some prefer thirty minutes, while others insist upon a full hour.

VENTURA COUNTY HORTICULTURAL COMMISSIONER
E. O. ESSIG

FUMIGATING SCHEDULE FOR BLACK SCALE
SODIUM CYANIDE
DISTANCE AROUND, IN FEET

DISTANCE OVER, IN FEET.

	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48										
10	1	1	1	1	1																						10
12	1	1	2	2	2	2																					12
14	2	2	2	2	2	2	3	3	3	3	3	4															14
16	2	2	2	2	3	3	3	3	3	4	4	4	4	4													18
18	2	2	2	3	3	3	4	4	4	4	4	4	4	5													18
			20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60				
20			2	3	3	4	4	4	4	4	4	5	5	5	5	5	6	6									20
22					4	4	4	4	4	4	5	5	5	5	6	6	6	6									22
24						4	4	4	5	5	5	5	6	6	6	6	7	7									24
26							4	5	5	5	5	6	6	6	6	7	8	8	8	8	8	8					26
28								5	5	6	6	6	6	7	7	8	8	8	8	8	9	9					28
								30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	
30								5	6	6	6	7	7	8	8	8	8	8	8	9	10	11	11	11	11	12	12	30
32											7	8	8	8	8	9	9	9	10	10	11	11	11	11	12	12	13	32
34												8	8	8	9	10	10	11	11	11	11	11	12	12	13	13	13	34
36												8	8	9	10	10	11	11	11	11	12	13	13	13	13	14	14	36
38													9	9	10	11	11	11	12	12	13	13	13	14	14	14	15	38
													40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	
40													9	10	11	11	11	11	12	13	13	14	14	14	15	15	15	40
41														11	11	11	11	12	13	13	14	14	14	15	15	15	16	42
42															11	11	12	13	13	14	14	14	15	15	15	16	16	44
43																12	13	13	14	14	14	15	15	15	15	16	17	46
44																		13	14	14	14	15	15	15	16	17	17	48
																		50	52	54	56	58	60	62	64	66	68	
45																		13	14	14	15	15	15	16	17	17	17	50
46																		14	14	15	15	15	16	17	17	17	17	52
47																		14	14	15	15	16	17	17	17	17	18	54
48																		14	15	15	16	17	17	17	17	18	18	56
49																		14	15	16	16	17	17	17	17	18	19	58

NOTE.—Quarter and half ounces are omitted to make the schedule more practical for field conditions.
Proportions for mixing chemicals—Sodium Cyanide 1, Sulphuric Acid 1½, Water 2.

FIG. 318.—Dosage schedule No. ½ for black scale using sodium cyanide as prepared by Woglum. (Essig, P. C. Jr. Ent.)

TIME OF OPERATION.

For red, purple and yellow scale fumigation work is usually done during the winter or spring months. If black scale is present the time of operation covers the period from the middle of August to the middle of January, depending somewhat upon the individual locality.

TEMPERATURE.

To avoid the heat of the sun, fumigation is ordinarily done during the night, when the atmosphere is cool. Cloudy cool days may admit of some work, but all day operations are liable to cause severe burnings of fruit and foliage.

Excessive coldness is also liable to cause disastrous results. Keep a thermometer on the wagon and do not operate under the following conditions: when the temperature is 70 degrees Fahr. or more above zero or when it is 36 degrees Fahr. or less. This latter temperature should be carefully avoided especially upon damp or wet nights.

Hot, electric winds also aid to produce severe burning and all work should be suspended on nights they are blowing.

Orchards subsequently sprayed with Bordeaux mixture should not be fumigated as there results a chemical reaction which is exceedingly damaging to the fruit and foliage.

BUYING MATERIALS.

Fumigating acid and cyanide are usually bought in large lots by the fumigating contractor, the various associations, the counties and large

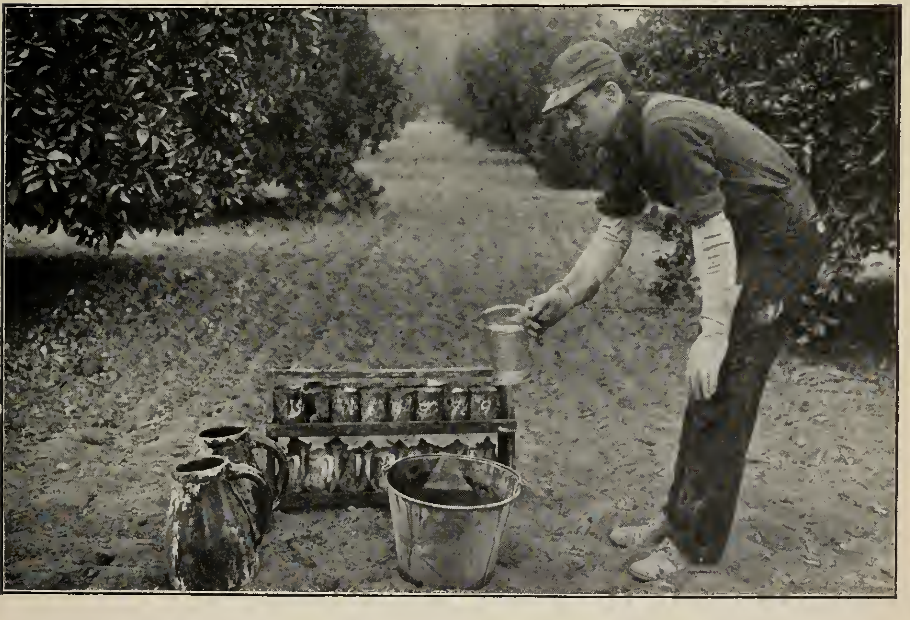

FIG. 319.—Method of dosing under the estimating system, which is fast being replaced by the Morrill system. (After Pierce, P. C. Jr. Ent.)

orchard companies who are able to get the benefits of a much reduced price. Until within the last few years the owner of a small orchard was not thus benefited unless the association to which he belonged or the county bought his materials. A coöperative company in the southern part of the State composed of the citrus growers themselves and known as the Fruit Growers' Supply Company, now gives its members the advantage of the prices obtained by making large purchases.

BLOCK FUMIGATION.

The spread of scale insects in citrus orchards is very rapid and under ordinary methods of fumigation, where only part of a district is treated each year, there is always a source of re-infestation from the trees which have not been fumigated for from one to several years. To eliminate this condition it is exceedingly desirable to fumigate large blocks or tracts of orchards the same year and thus place each upon the same basis. This is known as block fumigation and should be encouraged in every possible way, as it has great advantages over the usual haphazard fumigation of a district.

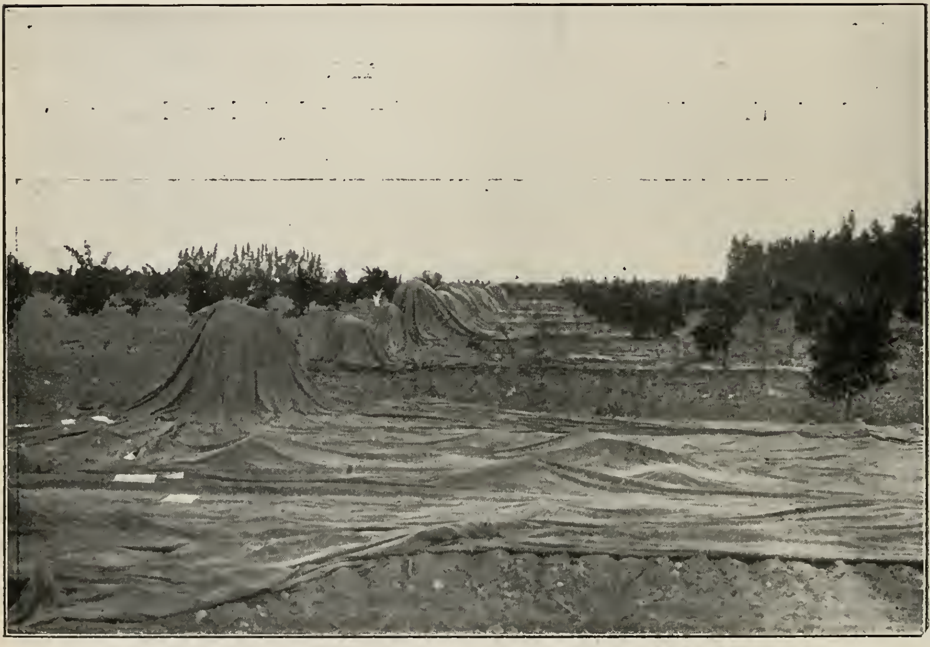

Fig. 320.—Using large tents for small trees. Not a good practice for the tents. (After Pierce, P. C. Jr. Ent.)

COST OF MATERIALS.

The following prices are a fair idea of average cost of supplies used in fumigating work:

TENTS.

Sizes		Double Filled.	
24 x 24 6½ ounce drill	$8 60	8 ounce Army duck	$11 25
30 x 30 6½ ounce drill	13 65	8 ounce Army duck	17 85
36 x 36 6½ ounce drill	19 50	8 ounce Army duck	25 50
41 x 41 6½ ounce drill	25 60	8 ounce Army duck	33 45
45 x 45 6½ ounce drill	29 90	8 ounce Army duck	39 10
64 x 64 6½ ounce drill	62 40	8 ounce Army duck	81 60
80 x 80 6½ ounce drill	98 50	8 ounce Army duck	128 70

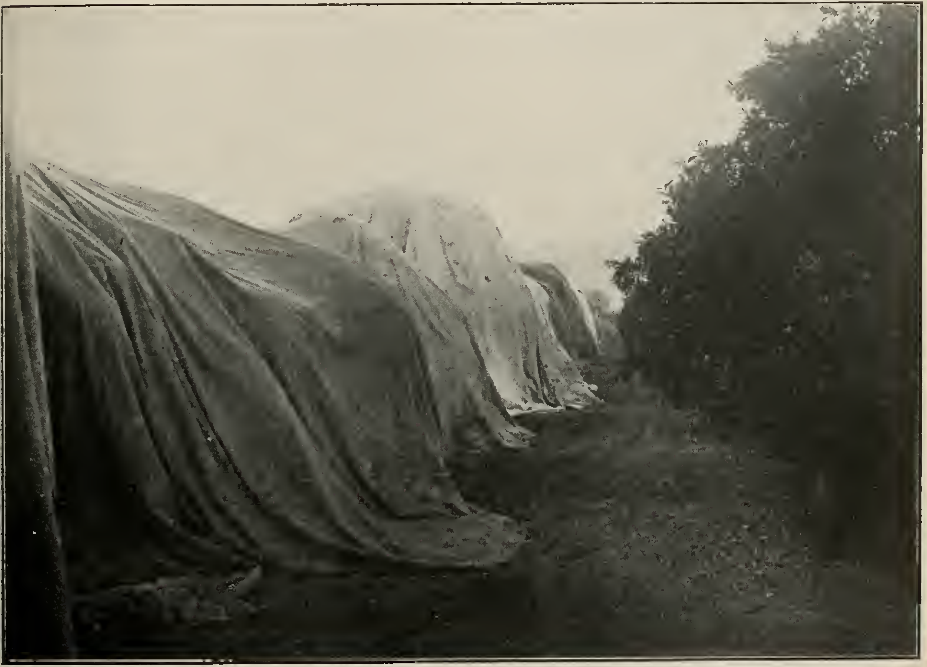

FIG. 321.—Row of fumigating tents showing the great difference in the size of the trees and emphasizing the need of measuring to ascertain the individual dosages. (After Pierce, P. C. Jr. Ent.)

MISCELLANEOUS SUPPLIES.

Generators.

	1 gal.	1 1-2 gal.	2 gal.	3 gal.
Dozen	$3 60	$6 00	$7 20	$10 20
Crating per dozen (extra)	65	65	70	70

Hinged covers to fit: $0.30 each; $3.00 per dozen.

Graduates.

Water $0 75.
Acid 8 ounces, $0 20; 16 ounces, $0 30.

MISCELLANEOUS SUPPLIES—Continued.

Pure rubber tubing, ½ inch	$1 05 per yard.
Pure rubber tubing, ⅝ inch	1 35 per yard.
Acid cut-offs	50c each; $6 00 per dozen
Acid tanks, lead, 5 gallons	$15 00
Acid tanks, stone, 5 gallons	6 00
Acid tanks, stone, 10 gallons	7 00
Made up 5-gallon stone jars cost from $4 00 to $5 00.	
Tape cloth, 75-foot	$ 3 30
Tape-cloth, 100-foot	3 90
Tape steel, 75-foot	5 00
Tape steel, 100-foot	5 75
Rubber gloves	$2 50 per pair.
Cyanide Scales	$3 50 to $4 00
Thermometer	$1 25 to $3 15
Acid hand cart (Mfg.)	90 00
Acid hand cart made up	35 00
Acid wagon (Mfg.)	$100 00 to $200 00
Acid cart for horse made up	35 00 to 100 00

Sulphuric Acid.

The price varies somewhat but is about 1½ cents per pound.

Cyanide.

Potassium cyanide averages from 25 to 25½ cents a pound in large lots, while sodium costs from 2 to 4 cents more per pound.

CALIFORNIA COMPANIES CARRYING FUMIGATING SUPPLIES.

The Braun Corporation (General)	Los Angeles, Cal.
Braun-Knecht-Heimann (General)	San Francisco, Cal.
California Drug and Chemical Co. (General)	Los Angeles, Cal.
Fruit Growers' Supply Co. (General)	Los Angeles, Cal.
Haas, Baruch & Co.	Los Angeles, Cal.
Mellus Bros. (Tents)	Los Angeles, Cal.
Mountain Copper Co. (Acid)	San Francisco, Cal.
The American Agricultural Chemical Co. (Acid)	Los Angeles, Cal.
Wm. Hoegee Co. (Tents)	Los Angeles, Cal.

CALIFORNIA HORTICULTURAL LAWS AND QUARANTINE ORDERS RELATING TO INSECTS.

(Repealed quarantine orders and those covered by State and national laws are not included here.)

AN ACT RELATING TO THE STATE COMMISSIONER OF HORTICULTURE.

[Approved April 26, 1911.]

§ 2319, Political Code. The State Commissioner of Horticulture of California shall be a citizen and resident of this State, and his term shall be for four years, and until his successor is appointed and qualified. The Governor may remove such Commissioner from office at any time upon filing with the Secretary of State a certificate of removal signed by the Governor. In the case of vacancy in said office by death, resignation, removal from office, or other cause the Governor shall fill the vacancy for the unexpired term. In appointing such Commissioner and his successor or successors, it shall be the duty of the Governor to disregard political affiliations, and to be guided in his selection entirely by the professional and moral qualifications of the person so selected for the performance of the duties of said office. Said Commissioner shall be a civil executive officer. The salary of said Commissioner shall be four thousand dollars per annum, and he shall be allowed his traveling and incidental expenses necessary in the discharge of his duties. For the direction and accomplishment of his work the said Commissioner may and is hereby empowered to appoint certain deputies, secretary, quarantine officers, superintendents, assistants, and clerk as hereinafter provided, who shall hold office at the pleasure of said Commissioner and perform any and all duties pertaining to their office or employment which the said Commissioner may require of each of them, and may be removed from office or position at any time by said Commissioner filing with the Secretary of State a certificate signed by said Commissioner so removing such deputy, secretary, quarantine officer, superintendent, assistant, or clerk. The traveling and other necessary expenses incurred by the officers and employees herein provided for in the performance of their duties shall be paid from the funds appropriated for the support of the office of State Commissioner of Horticulture. Said Commissioner may arrange his office into three divisions, to wit: executive office, quarantine division, insectary and pathological division. Said Commissioner may appoint a chief deputy who shall be an expert entomologist and horticulturist and shall have charge of the work in the field and shall represent the Commissioner ex officio with the county horticultural commissioners when so authorized in accordance with the provisions of the law. Such chief deputy shall receive a salary of two thousand four hundred dollars per annum. Said Commissioner may appoint a secretary, who shall be a civil executive officer. Said secretary shall be versed in horticulture and entomology and shall compile such bulletins and such publications as may issue from the office of said Commissioner from time to time, and shall perform all other duties as may be required of him by said Commissioner. Such secretary shall receive a salary of two thousand four hundred dollars per annum. Said Commissioner may appoint a clerk whose salary shall be one thousand five hundred dollars per annum. The main office of such Commissioner shall be at the city of Sacramento. The Secretary of State shall furnish and set aside at the capitol a room or rooms suitable for offices for said Commissioner, and if the Secretary of State shall make and file an affidavit with the said Commissioner stating that it is not possible for him, as such Secretary of State, to provide and set aside an office for said Commissioner in the Capitol or in any State building under his control, because there is no such office room or rooms available, then, and after the making and delivery of such affidavit to such Commissioner, the said Commissioner may rent rooms convenient and suitable for his offices at a rental not to exceed one thousand dollars per year. The office of said Commissioner shall be kept open every day except holidays, and shall be in charge of the secretary, during the absence of the Commissioner. Said Commissioner may also keep and maintain an office in the city and county of San Francisco at a yearly rental not to exceed the sum of five hundred dollars. Said Commissioner may appoint for the work of the quarantine division a chief deputy quarantine officer who shall be a skilled entomologist and particularly conversant with the nature of foreign insect pests and diseases and effective means of preventing their introduction, and shall have charge of the Commissioner's San Francisco office provided for in this section of this act. Such chief deputy quarantine officer shall receive a salary of two thousand four hundred dollars per annum. Said Commissioner may appoint a deputy quarantine officer who shall be a competent entomologist for the purpose of quarantine work. Such deputy quarantine officer shall receive a salary of one thousand eight hundred dollars per annum. Said Commissioner shall also properly maintain and operate the State Insectary located on the State Capitol Grounds in Sacramento from funds provided by law for such purpose, and shall appoint for the work of the insectary division a superintendent of the insectary, who shall be an expert entomologist able to perform all the necessary duties with reference to the importation, rearing and distribution of beneficial insects. The salary of the superintendent of the State Insectary shall be two thousand four hundred dollars per annum. Said Commissioner may appoint an assistant superintendent of the insectary, who shall be an economic entomologist, at a salary of one thousand eight hundred dollars per annum. Said Commissioner may appoint a field deputy for the insectary division, who shall be a practical entomologist and whose salary shall be one thousand five hundred dollars per annum. The salaries of all the officers above mentioned shall be paid at the same time and in the same manner as the salaries of other State officers. Said Commissioner may also appoint, by and with the approval of the Governor, such temporary deputies from time to time as may be required and such temporary deputies shall receive such reasonable compensation per diem as may be fixed by said Commissioner.

§ 2319*a*. Such Commissioner shall collect books, pamphlets and periodicals and other documents containing information relating to horticulture and shall preserve the same; collect statistics and other information showing the actual condition and progress of horticulture in this State and elsewhere; correspond with horticultural societies, colleges and schools, and with the county horticultural commissioners existing or that may exist in this State, and with all other persons necessary to secure the best results to horticulture in this State. He shall require reports from county horticultural commissioners in this State, and may print the same or any part thereof as he may select, either in the form of bulletins or in his annual reports or both, as he shall deem proper. He shall issue and cause to be printed and distributed to county horticultural commissioners in this State, and to such other persons as he may deem proper, bulletins or statements containing all the information best adapted to promote the interest and protect the business and development of horticulture in this State. Such Commissioner shall be deemed to be the State horticultural quarantine officer mentioned in that certain act entitled, "An act for the protection of horticulture, and to prevent the introduction into this State of insects, or diseases, or animals injurious to fruit or fruit trees, vines, bushes or vegetables, and to provide for a quarantine for the enforcement of this act," which became a law under constitutional provisions without the Governor's approval on March 11th, 1899, for the purposes of that act, and shall be empowered to perform the duties which under that act are to be performed by the State horticultural quarantine officer; *provided*, that in any case where it shall become necessary in the judgment of the State Commissioner of Horticulture to quarantine a county or districts within the State against another or other county or counties or districts within the State, or to quarantine the State or a county or district of the State against another state or a foreign country or countries then it shall be necessary that said quarantine shall be made by and with the approval of the Governor as provided in this chapter.

The State Commissioner of Horticulture may issue commissions as quarantine guardians to the county horticultural commissioners, deputies and inspectors appointed by them.

§ 2319 *b*. Said Commissioner may, by and with the approval of the Governor, establish, maintain and enforce such quarantine regulations as may be deemed necessary to protect the nurseries, trees, shrubs, plants, vines, cuttings, grafts, scions, buds, fruit-pits, fruit, seeds, vegetables or other articles of horticulture, against contagion or infection by injurious disease, insects or pests, by establishing such quarantine at the boundaries of this State or elsewhere within the State, and he may make and enforce, with the approval of the Governor, any and all such rules and regulations as may be deemed necessary to prevent any infected stock, tree, shrub, plant, vine, cutting, graft, scion, bud, fruit-pit, fruit, seeds, vegetable or other article of horticulture, from passing over any quarantine line established and proclaimed pursuant to this act, and all such articles shall, during the maintenance of such quarantine, be inspected by such Commissioner or by deputies appointed in writing by said Commissioner, and he and the deputies so conducting such inspection shall not permit any such article to pass over such a quarantine line during such quarantine, except upon a certificate of inspection signed by such Commissioner or in his name by such a deputy who has made such inspection. All approvals by the Governor given or made pursuant to this act shall be in writing and signed by the Governor in duplicate, and one copy thereof shall be filed in the office of the Secretary of State and the other in the office of said Commissioner before such approval shall take effect.

§ 2319*c*. Upon information received by such Commissioner of the existence of any infectious disease, insect or pest, dangerous to any article, or to the interests of horticulture within this State, or that there is a probability of the introduction of any such infectious disease, insect or pest into this State or across the boundaries thereof, he shall proceed to thoroughly investigate the same and may establish, maintain and enforce quarantine as hereinbefore provided, with such regulations as may be necessary to circumscribe and exterminate or eradicate such infectious diseases, insects or pests, and prevent the extension thereof, and is hereby authorized to enter upon any ground or premises, and inspect any stock, tree, shrub, plant, vine, cutting, graft, scion, bud, fruit-pit, fruit, seed, vegetable or other article of horticulture or implement thereof or box or package pertaining thereto, or connected therewith or that has been used in packing, shipping or handling the same, and to open any such package, and generally to do, with the least injury possible under the conditions to property or business, all acts and things necessary to carry out the provisions of this chapter.

§ 2319*d*. Upon the discovery of any infectious disease, insects or pests, such Commissioner shall immediately report the same to such quarantine guardians, county horticultural commissioners or county boards of horticulture of such counties as are affected or liable to be affected by the disease, insect or pest, together with a statement as to the best known means or method for circumscribing, exterminating or eradicating the same, and shall state therein specifically what treatment or method should be applied in each case, as the matter may require, with a detailed statement or prescription as to the method of making or procuring and of applying any preparation or treatment so recommended therefor, and the time and duration for such treatment, and if chemicals or articles be required other than those usually obtainable in any town, the place or places where they are most readily to be obtained, and upon the receipt of such statement by any quarantine guardian, county horticultural commissioner or county board of horticulture, or any member thereof it shall be the duty of such quarantine guardian, county horticultural commissioner or county board of horticulture to distribute such statement in written or printed form to every person owning or having charge or possession of any orchard, nursery stock, tree, shrub, plant, fruits or article of horticulture within their county, where there may be or be likely to be any danger to the interests of horticulture, and such a statement must be served with or be a part of the notice to be given to the owner or owners or person or persons, in possession of any orchard, nursery, tree, shrub, plants, fruits or other articles of horticulture, referred to, provided for, and required to be served in and by section 2 of chapter 183 of the Laws of 1897 or any amendments which have been or may be made thereto.

§ 2319*e*. Whenever it shall be necessary to establish quarantine under this chapter, if there be any authorities or officers of the United States having authority to act in such matter, or any part thereof, the said State Commissioner of Horticulture shall notify such authorities or officers of the United States, seeking their coöperation as far as possible wheresoever the jurisdiction of the United States extends and is being exercised. The said Commissioner shall at once notify the Governor of all quarantine lines established under or pursuant to this chapter, and if the Governor approve or shall have approved of the same or any portion thereof the same shall be in effect and the Governor may issue his proclamation proclaiming the boundaries of such quarantine and the nature thereof, and the order, rules or regulations prescribed for the maintenance and enforcement of the same, and may publish said proclamation in such manner as he may deem expedient to give proper notice thereof.

§ 2319*f*. The said State Commissioner shall be ex officio a county commissioner of horticulture wherever such county commissioner has been appointed or may hereafter be appointed or exist in this State pursuant to law, whenever he is present and acting with said county horticultural commissioner within such county where such commissioner has been appointed.

§ 2319*g*. It shall be the duty of Superintendent of State Printing to print and deliver to the State Commissioner of Horticulture, upon the written request of said Commissioner, all such bulletins, orders, rules, regulations, statements, reports and other printed matter, as the said Commissioner may deem necessary to have and use for carrying out the purpose of this chapter, and it shall be the duty of the Secretary of State to cause to be prepared and furnished to such State Commissioner all stationery, paper, blank forms, envelopes, and writing material needful and convenient for use in the office of such Commissioner.

§ 2319*h*. It shall be the duty of the State Commissioner of Horticulture to report in the month of January in each even-numbered year to the Governor, and in each odd-numbered year to the legislature of this State the horticultural conditions of the State with statistics regarding the same, the efficiency of the work of the county horticultural commissioners of the State, and such other matters as he may deem expedient or as may be required either by the Governor or legislature, and to include a statement of all the persons employed and moneys expended under this chapter by itemized statement thereof.

§ 2319*i*. Any person wilfully refusing to comply with orders lawfully made under and pursuant to this chapter shall be guilty of a misdemeanor, and upon conviction shall be fined not to exceed five hundred dollars.

§ 2319*j*. All moneys paid hereunder shall be paid by the State Treasurer from moneys appropriated for the support of the office of State Commissioner of Horticulture, and expenses other than the salary of the Commissioner, the compensation of his deputies, secretary, quarantine officers, superintendents, assistants, and clerk, as allowed and provided by this chapter, must be certified by the said Commissioner and be approved by the state board of examiners before being audited and paid.

AN ACT RELATING TO THE COUNTY COMMISSIONER OF HORTICULTURE.

[Approved March 25, 1911.]

The people of the State of California, represented in Senate and Assembly, do enact as follows:

§ 2322, Political Code. Whenever a petition is presented to the board of supervisors of any county, or city and county, and signed by twenty-five or more persons each of whom is a resident freeholder and possessor of an orchard, or greenhouse or nursery, stating that certain or all orchards, or nurseries or trees or plants of any variety are infested with any serious infectious diseases, or insects of any kind injurious to fruit, fruit trees, vines, or other plants or vegetables, or that there is growing therein the Russian thistle or saltwort (*Salsoli kali* var. *tragus*), Johnson grass (*Sorghum halepense*) or other noxious weeds, codlin moth or other insects that are destructive to trees and plants; and praying that a commissioner be appointed by them, whose duties shall be to supervise the destruction of said insects, diseases or Russian thistle or saltwort, Johnson grass or other noxious weeds, as herein provided, the board of supervisors shall immediately notify the state board of horticultural examiners to furnish them a list of eligibles or competent persons as hereinafter provided, and from such list the said supervisors shall appoint a Commissioner in accordance with the provisions of this chapter, whose term of office shall be for four years and until his successor shall be appointed and qualified and who shall give a bond in the sum of one thousand dollars for the faithful performance of his duties. The said term of office of any and all county commissioners heretofore or hereinafter appointed shall commence on the date of appointment, and be for a period of four years and until his successor shall be appointed and qualified, at the end of which period the said term shall terminate, and said term shall run with and be attached to said office. In any case where such petition has already been presented or submitted, or is on file at the time of the passage of this act, as the basis for the appointment of a board of horticultural commissioners under this chapter as heretofore existing, such petition shall continue in full force and effect and the board of supervisors of any county, or city and county with which any such petition has been filed, or in which any board of horticultural commissioners has heretofore existed, must appoint a county horticultural commissioner. The person appointed to such position must be specially qualified for his duties and must be chosen and appointed by the board of supervisors from a list of eligible persons recommended and nominated to said board as hereinafter provided, such appointment to be made within thirty days after receipt of said list by said board of supervisors, and the said board of supervisors shall provide a suitable office for the said commissioner and all necessary expenses in the maintenance of said office shall be paid by said board of supervisors. A state board of horticultural examiners is hereby created consisting of the Dean of the Agricultural College of the University of California, the State Commissioner of Horticulture and the superintendent of the State Insectary, who are ex officio members of said board. They shall serve without pay and said board shall provide convenient means for the examination of candidates for appointment as horticultural commissioner. While in the performance of their duties as members of said board they shall be allowed all their necessary expenses for traveling, printing, postage and other incidental matters to be paid out of any appropriations made for the support of the office of the State Commissioner of Horticulture. At least thirty days before the date of the examination of candidates for the said appointments the state board of horticultural examiners shall post or cause to be posted in three public places in said county notice of the time and place at which such examination will be held, setting forth the conditions and subjects of said examination. At the time and place stated and agreed upon such examination shall be held. Said examination shall be in writing and the board of horticultural examiners may appoint one of their own number, or some other reliable, competent person to conduct the holding of such examination in each county and forward the papers of each applicant to the board for consideration. Within twenty days after the examination is held said examiners shall certify to the board of supervisors of the county, or city and county for which the examination was had, the names of such persons examined as they deem competent and qualified for the office and from the list of names so certified the supervisors shall within thirty days after the receipt of said list of names appoint a horticultural commissioner. As far as possible the board of horticultural examiners shall consult the resident horticulturists of the county in determining the responsibility and moral qualifications of candidates for appointment as commissioners and whose names they certify to the boards of supervisors of the several counties. If no person or persons present themselves for examination before said board of horticultural examiners or if after such examination no person is found qualified, the state board of horticultural examiners shall name five competent persons and certify them to the board of supervisors and from these names the board of supervisors shall within thirty days after the receipt thereof appoint a county horticultural commissioner, and in such event the commissioner so appointed shall hold office for the term of one year. In case of a vacancy in the office of horticultural commissioner, the vacancy shall be filled first from the list of eligibles certified to the board of supervisors under the provision of this chapter, and if there be no person named on the said list of eligible persons as in this section first above provided, then said vacancy shall be filled from the list of competent persons named as in this section last above provided, and if said vacancy shall be filled from the said list of eligibles the said person so appointed shall hold for the balance of the unexpired term, but if the said vacancy be filled from the said list of competent persons, the said person shall hold for the balance of the unexpired term, if the said unexpired term be not longer than one year, but if said unexpired term be longer than one year then such person shall not by virtue of such appointment hold longer than one year from the date of his appointment. Whenever elsewhere in the laws of this State reference is made to a county board of horticultural commissioners such reference must be understood to mean or relate to the county horticultural commissioner herein provided for and said county board of horticultural commissioners and the members thereof shall cease to exist as such; *provided*, that all county boards of horticultural commissioners existing at the time of the passage of this act shall continue in office, with full power as heretofore existing until the election or appointment to succeed them, of a county horticultural commissioner under the provisions of this act. Upon the petition of twenty-five resident freeholders who are possessors of an orchard, greenhouse or nursery the board of supervisors may remove said commissioner for neglect of duty or malfeasanse in office after hearing of the petition. In case of such removal upon such hearing, the board shall immediately proceed to fill said office for the unexpired term as in cases of vacancy as hereinbefore provided.

§ 2322*a*. It shall be the duty of the county horticultural commissioner in each county, whenever he shall deem it necessary, to cause an inspection to be made of any premises, orchards or nursery, or trees, plants, vegetables, vines, or fruits, or any fruit-packing house, storeroom, salesroom, or any other place or article in his jurisdiction, and if found infected with infectious diseases, scale insects, or codlin moth, or other pests injurious to fruit, plants, vegetables, trees, or vines, or with their eggs, or larvæ, or if there is found growing thereon the Russian thistle or saltwort, Johnson grass or other noxious weeds, he shall in writing notify the owner or owners, or person or persons in charge, or in possession of the said places or orchards or nurseries, or trees, or plants, vegetables, vines, or fruit, or article as aforesaid, that the same are infected with said diseases, insects, or other pests, or any of them, or their eggs or larvæ, or that the Russian thistle or saltwort, Johnson grass or other noxious weeds is growing thereon, and require such person or persons, to eradicate or destroy the said insects, or other pests, or their eggs or larvæ, or Russian thistle or saltwort, Johnson grass or other noxious weeds within a certain time to be therein specified. Said notices may be served upon the person or persons, or either of them, owning or having charge, or having possession of such infested place or orchard, or nursery, or trees, plants, vegetables, vines, or fruit, or articles, as aforesaid, or premises where the Russian thistle or saltwort, Johnson grass or other noxious weeds shall be growing, or upon the agents of either, by any commissioner, or by any person deputed by the said commissioner for that purpose in the same manner as a summons in a civil action; *provided, however*, that if any such infected or infested articles, property or premises as hereinabove specified belong to any non-resident person and there is no person in control or possession thereof and such non-resident person has no tenant, bailee, depositary or agent upon whom service can be had; or if the owner or owners of any such articles, property or premises can not after due diligence be found, then such notice may be served by posting the same in some conspicuous place upon such articles, property or premises, and by mailing a copy thereof to the owner thereof at his last known place of residence, if the same is known or can be ascertained. Any and all such places, or orchards, or nurseries, or trees, plants, shrubs, vegetables, vines, fruit, or articles thus infested, or premises where the Russian thistle or saltwort or Johnson grass or other noxious weeds shall be growing, are hereby adjudged and declared to be a public nuisance; and whenever any such nuisance shall exist at any place within his county, and the proper notice thereof shall have been served, as herein provided, and such nuisance shall not have been abated within the time specified in such notice, it shall be the duty of the county horticultural commissioner to cause said nuisance to be at once abated, by eradicating or destroying said diseases, insects, or other pests, or their eggs, or larvæ, or Russian thistle or saltwort or Johnson grass or other noxious weeds. The expense thereof shall be a county charge, and the board of supervisors shall allow and pay the same out of the general fund of the county. Any and all sum or sums so paid shall be and become a lien on the property and premises from which said nuisance has been removed or abated in pursuance of this chapter. A notice of such lien shall be filed and recorded in the office of the county recorder of the county in which the said property and premises are situated, within thirty days after the right to the said lien has accrued. An action to foreclose such lien shall be commenced within ninety days after the filing and recording of said notice of lien, which action shall be brought in the proper court by the district attorney of the county in the name and for the benefit of the county making such payment or payments, and when the property is sold, enough of the proceeds shall be paid into the county treasury of such county to satisfy the lien and costs; and the overplus, if any there be, shall be paid to the owner of the property, if he be known, and if not, into the court for his use when ascertained. The county horticultural commissioner is hereby vested with the power to cause any and all such nuisances to be at once abated in a summary manner.

§ 2322*b*. Said county horticultural commissioner shall have power to divide the county into districts, and to appoint a local inspector, to hold office at the pleasure of the commissioner, for each of said districts, and may with the consent and approval of the board of supervisors, appoint a deputy horticultural commissioner from a list of qualified persons certified to the board of supervisors by the state board of horticultural examiners, such deputy to hold office at the pleasure of the commissioner. The State Commissioner of Horticulture may issue commissions as quarantine guardians to the county horticultural commissioner, the deputy and inspectors appointed by him. The said quarantine guardians, local inspectors, deputies or the said county horticultural commissioner, have full authority to enter into any orchard, nursery, place or places where trees or plants or fruit are kept and offered for sale or otherwise, or any house, storeroom, salesroom, depot, or any other such place in their jurisdiction, to inspect the same, or any part thereof.

§2322*c*. It is the duty of the said county horticultural commissioner to keep a record of his official doings and to make a report to the State Commissioner of Horticulture on or before the first day of October of each year of the condition of the horticultural interests in their several districts, what is being done to eradicate insect pests, also as to disinfecting, and as to quarantine against insect pests and dieases, and as to the carrying out of all laws relative to the greatest good of the horticultural interests, and to furnish from time to time to the State Commissioner of Horticulture such other information as he may require. Said State Commissioner of Horticulture may publish such reports in bulletin form or may incorporate so much of the same in his annual report as may be of general interest. It is also made the duty of the county horticultural commissioner to advise himself with reference to all infectious diseases, scale insects or codlin moth or other pests injurious to fruit, plants, vegetables, trees or vines, and with their eggs or larvæ and all noxious weeds or grasses that may exist in his county or be likely to exist therein and for the purpose of so advising himself and of eradicating and preventing injury from such causes, and for the purpose of advising himself on the best and most efficacious methods of performing his duties and conducting his office he shall attend the annual meeting of the state association of county horticultural commissioners, and such other meetings as the State Commissioner of Horticulture shall require, and he shall be paid his per diem compensation and traveling expenses while so engaged.

§ 2322*d*. The salary of all inspectors working under the county horticultural commissioner is three dollars and fifty cents per day. The salary of the deputy shall be five dollars per day when in the actual performance of his duties and the necessary traveling expenses. In the case of the commissioner himself his compensation shall be six dollars per day when actually engaged in the performance of his duties, and the necessary traveling expenses incurred in the discharge of his regular duties as described in this chapter.

§ 2322*e*. It is the duty of the county horticultural commissioner to keep a record of his official acts, and make a monthly report to the board of supervisors; and the board of supervisors may withhold warrants for salary of said commissioner, deputy and inspectors until such time as such report is made.

STATE QUARANTINE LAW.

[Approved January 2, 1912.]

The people of the State of California do enact as follows:

SECTION 1. Any person, persons, firm or corporation who shall receive, bring or cause to be brought into the State of California, any nursery stock, trees, shrubs, plants, vines, cuttings, grafts, scions, buds or fruit pits, or fruit or vegetables, or seed, shall immediately after the arrival thereof notify the State Commissioner of Horticulture, or deputy quarantine officer, or quarantine guardian of the district or county in which such nursery stock, or fruit or vegetables or seed are received, of their arrival, and hold the same without unnecessarily moving the same, or placing such articles where they may be harmful, for the immediate inspection of such State Commissioner of Horticulture, or deputy quarantine officer or guardian. If there is no quarantine guardian or state horticultural quarantine officer in the county where such nursery stock or fruit or vegetable, or seed is received, it shall then be the duty of such person, persons, firm or corporation to notify the State Commissioner of Horticulture, who shall make immediate arrangements for their inspection. The State Commissioner of Horticulture, deputy quarantine officer, quarantine guardian or such person or persons as shall be commissioned by the State Commissioner of Horticulture to make such inspection, or to represent said Commissioner, is hereby authorized and empowered to enter at any time into any car, warehouse, depot or upon any ship within the boundaries of the State of California whether in the stream or at the dock, wharf, mole, or any other place where such nursery stock or fruit or vegetables or seed or other described articles are received or in which such nursery stock or fruit or vegetables or seed is imported into the State, for the purpose of making the investigation or examination to ascertain whether such nursery stock, trees, shrubs, plants, vines, cuttings, grafts, scions, buds, fruits, pits, fruit, vegetables or seed is infested with any species of injurious insects, or their eggs, larvæ or pupæ or other animal or plant disease.

If after such examination or inspection, any of the said described articles are found to be so infested or infected as aforesaid, then it shall be the duty of the owner, owners, or persons, firm or corporation having charge or possession thereof to so disinfect at his or their expense such portion or portions of the ship, dock, wharf, mole, car, warehouse or depot where said articles may have been located in such a manner as to destroy all infection or infestation present or that is liable to be present, and all articles or packages or soils apt to be so infested or infected shall be held until the said articles or packages or soils have been thoroughly disinfected and all injurious insects, or their eggs, larvæ or pupæ or other animal or plant disease have been eradicated and destroyed; *provided, however,* that all articles of nursery stock, trees, shrubs, plants, vines, cuttings, grafts, scions, buds, fruit pits, fruits, vegetables or seed which are infested or infected with such species of injurious insects or their eggs, larvæ or pupæ or other animal or plant disease which may be or be liable to be injurious to the orchards, vineyards, gardens or farms within said State, shall be destroyed or reshipped out of the State as hereinafter provided. The said officer so making such inspection shall not permit any of the described articles so coming in contact with said infested or infected articles or any articles which might convey infection or infestation to be removed or taken from any such car, warehouse, depot, ship, dock, wharf or any other place until after such infection or infestation shall have been destroyed.

SEC. 2. Each carload, case, box, package, crate, bale or bundle of trees, shrubs, plants, vines, cuttings, grafts, scions, buds, fruit-pits, or fruit or vegetables or seed, imported, or brought into this State, shall have plainly and legibly marked thereon in a conspicuous manner and place the name and address of the shipper, owner, or owners or person forwarding or shipping the same, and also the name of the person, firm or corporation to whom the same is forwarded or shipped, or his or its responsible agents, also the name of the country, state or territory where the contents were grown and a statement of the contents therein.

SEC. 3. When any shipment of nursery stock, trees, vines, plants, shrubs, cuttings, grafts, scions, buds, friut-pits or seed or vegetables or fruit, imported or brought into this State, is found infested or infected with any species of injurious insects, or their eggs, larvæ or pupæ or other animal or plant disease or there is reasonable cause to presume that they may be so infested or infected, which would cause damage, or be liable to cause damage, to the orchards, vineyards, gardens or farms of the State of California, or which would be or be liable to be detrimental thereto or to any portion of said State, or to any of the orchards, vineyards, gardens or farms within said State such shipment shall be immediately destroyed by the State Commissioner of Horticulture, his deputy quarantine officer, quarantine guardians or other person or persons, who shall be commissioned by the State Commissioner of Horticulture to make such inspection; *provided, however,* that if the nature of the injurious insects, or their eggs, larvæ, pupæ or animal or plant disease be such that no damage or detriment can be caused to the said orchards, vineyards, gardens or farms of California or any of the same by the shipment of the same out of the State, then the said State Commissioner of Horticulture, his deputy quarantine officer, quarantine guardians or other person or persons who shall be commissioned by the State Commissioner of Horticulture to make such inspection, and who shall make such inspection, shall notify the owner or person, firm or corporation having possession or control of said articles to ship the same out of the State within forty-eight hours after such notification, and it shall be the duty of such owner or owners, or person, firm or corporation, to so ship said articles, but such shipment shall be under the sole direction and control of the officer so making the inspection and shall be at the expense of the owner or owners, his or their agent or agents, and for a failure to comply with such notice such owner or owners, his or their agent or agents shall be deemed guilty of a violation of the terms of this act and be punished accordingly and immediately after the expiration of the time specified in said notice said articles shall be seized and destroyed by said officer at the expense of the said owner or owners, his or their agent or agents.

Sec. 4. When any shipment of nursery stock, trees, vines, plants, shrubs, cuttings, grafts, scions, fruit, fruit pits, vegetables or seed, or any other horticultural or agricultural product passing through any portion of the State of California in transit, is infested or infected with any species of injurious insects, their eggs, larvæ or pupæ or animal or plant disease, which would cause damage, or be liable to cause damage to the orchards, vineyards, gardens or farms of the State of California, or which would be, or be liable to be, detrimental thereto or to any portion of said State, or to any of the orchards, vineyards, gardens or farms within said State, and there exists danger of dissemination of such insects or disease while such shipment is in transit in the State of California, then such shipment shall be placed within sealed containers, composed of metallic or other material, so that the same can not be broken or opened, or be liable to be broken, or opened, so as to permit any of the said shipment, insects, their eggs, larvæ or pupæ or animal or plant disease to escape from such sealed containers and the said containers shall not be opened while within the State of California.

Sec. 5. No person, persons, firm or corporation shall bring or cause to be brought into the State of California any fruit or vegetable or host plant which is now known to be, or hereafter may become a host plant or host fruit of any species of the fruit fly family *Trypetidæ* from any country, state or district where such species of *Trypetidæ* is known to exist and any such fruit, vegetable, or host plant. together with the container and packing, shall be refused entry and shall be immediately destroyed at the expense of the owner, owners or agents.

Sec. 6. No person, persons, firm or corporation shall bring or cause to be brought into the State of California any peach, nectarine, or apricot tree or cuttings, grafts, scions, buds or pits of such trees, or any trees budded or grafted upon peach stock or roots that have been in a district where the disease known as "peach yellows" or the contagious disease known as "contagious peach rosette" are known to exist, and any such attempting to land or enter shall be refused entry and shall be destroyed or returned to the point of shipment at the option of the owner, owners or agent, and at his or their expense.

Sec. 7. No person, persons, firm or corporation shall bring or cause to be brought into the State of California any injurious animals known as English or Australian wild rabbit, flying fox, mongoose or any other animal or animals detriemntal to horticultural or agricultural interests.

Sec. 8. Any person, persons, firm or corporation violating any of the provisions of this act shall be guilty of a misdemeanor and shall be punished by imprisonment in the county jail for a period not exceeding six months, or by a fine not exceeding five hundred dollars, or by both such fine and imprisonment.

Sec. 9. It is hereby determined and declared that this act and each and all of the provisions thereof, constitute and is an urgency measure necessary for the immediate preservation of the public safety and health. The facts constituting such necessity are as follows: There now exists in various islands and territory in close proximity to the State of California dangerous and injurious fruit and plant diseases and insects and animals, and heretofore fruits, vegetables, plants, seeds and other articles of horticulture and agriculture from said islands and territory have been and now are being shipped and brought into the State of California, which are to a large extent infested and infected with dangerous and injurious fruit and plant diseases and insects, their eggs, larvæ and pupæ, and which if continued to be brought into the State will cause great danger to the public health, and will greatly damage the horticultural and agricultural interests of said State, and will also be detrimental to the public health, and this act is necessary to provide ample power to prevent the introduction of such insects and diseases and injurious animals into the State and to prevent the spread of such disease, insects and animals.

Sec. 10. That certain act entitled "An act for the protection of horticulture, and to prevent the introduction into this State of insects, or diseases, or animals, injurious to fruit or fruit trees, vines, bushes, or vegetables, and to provide for a quarantine for the enforcement of this act," approved March 11, 1899, is hereby repealed.

Sec. 11. This act, being an urgency measure as above set forth, shall take effect and be in full force immediately from and after its passage.

STATE INSECTICIDE AND FUNGICIDE LAW.

[Approved May 1, 1911.]

Section 1. That it shall be unlawful for any person to manufacture within this State any insecticide, paris green, lead arsenic, or fungicide which is adulterated or misbranded within the meaning of this act; and any person who shall violate any of the provisions of this section shall be guilty of a misdemeanor, and shall, upon conviction thereof, be fined not to exceed two hundred dollars for the first offense, and upon conviction for each subsequent offense be fined not to exceed three hundred dollars, or sentenced to imprisonment for not to exceed one year, or both such fine and imprisonment, in the discretion of the court. Said fines and those specified in section 2 of this act to be paid into the school fund of the county in which conviction is had.

Sec. 2. Any person who shall offer to deliver to any other person or any person who shall sell or offer for sale in this State any such adulterated or misbranded insecticide or paris green or lead arsenate or fungicide which is adulterated or misbranded within the meaning of this act, or export or offer to export the same to any foreign country shall be guilty of a misdemeanor, and for such offense be fined not exceeding two hundred dollars for the first offense, and upon conviction for each subsequent offense not exceeding three hundred dollars, or to be imprisoned not exceeding one year, or both, in the discretion of the court; *provided*, that no article shall be deemed misbranded or adulterated within the provisions of this act when intended for export to any foreign country and prepared or packed according to the specifications or directions of the foreign purchaser; but if said article shall be in fact sold or offered for sale for domestic use or consumption, then this proviso shall not exempt said article from the operation of any of the provisions of this act.

Sec. 3. The examination of specimens of insecticides, paris greens, lead arsenates and fungicides shall be made by the director of the agricultural experiment station of the University of California in person or by deputy, for the purpose of determining from such examination whether such articles are adulterated or misbranded within the meaning of this act; and if it shall appear from any such examination that any of such specimens are adulterated or misbranded within the meaning of this act, the said director shall cause notice thereof to be given to the party from whom such sample was obtained. Any party so notified shall be given an opportunity to be heard under the rules and regulations adopted by the United States Government for the enforcement of the national insecticide act of 1910, and if it appears that any of the provisions of this act have been violated by such party, then the said director shall at once certify the facts to the proper district attorney, with a copy of the results of the analysis or the examination of such article duly authenticated by the analyst or officer making such examination, under the oath of such officer. After judgment of the court, notice shall be given by publication in such manner as the said director may determine.

Sec. 4. That it shall be the duty of each district attorney to whom the said director shall report any violation of this act or present satisfactory evidences of any such violation, to cause appropriate proceedings to be commenced and prosecuted in the proper courts of the State of California without delay, for the enforcement of the penalties as in such case herein provided.

Sec. 5. In any action, civil or criminal, in any court in this State, a certificate, under the hand of said director, and the seal of said university, stating the results of any analysis purporting to have been made under the provisions of this act, shall be *prima facie* evidence of the fact that the sample or samples mentioned in said analysis or certificate were properly analyzed as in this act provided; that the substances analyzed contained the component parts stated in such certificate and analysis; and that the samples were taken from the parcels or packages or lots mentioned or described in said certificate.

Sec. 6. That the term "insecticide" as used in this act shall include any substance or mixture of substances intended to be used for preventing, destroying, repelling or mitigating any insects which may infest vegetation, man or other animals, or households, or be present in any environment whatsover. The term "paris green" as used in this act shall include the product sold in commerce as paris green and chemically known as the aceto-arsenite of copper. The term "lead arsenate" as used in this act shall include the product or products sold in commerce as lead arsenate and consisting chemically of products derived from arsenic acid (H_3AsO_4) by replacing one or more hydrogen atoms by lead. That the term "fungicide" as used in this act shall include any substance or mixture of substances intended to be used for preventing, destroying, repelling, or mitigating any and all fungi that may infest vegetation or be present in any environment whatsoever.

Sec. 7. That for the purpose of this act an article shall be deemed to be adulterated—

In case of paris green: *first,* if it does not contain at least fifty per centum of arsenious oxide; *second,* if it contains arsenic in water-soluble forms equivalent to more than three and one half per centum of arsenious oxide; *third,* if any substance has been mixed and packed with it so as to reduce or lower or injuriously affect its quality or strength.

In the case of lead arsenate: *first,* if it contains more than fifty per centum of water; *second,* if it contains total arsenic equivalent to less than twelve and one half per centum of arsenic oxide (As_2O_5); *third,* if it cnotains arsenic in water-soluble forms equivalent to more than seventy-five one-hundredths per centum of arsenic oxide (As_2O_5); *fourth,* if any substances have been mixed and packed with it so as to reduce, lower, or injuriously affect its quality or strength; *provided, however,* that extra water may be added to lead arsenate (as described in this paragraph) if the resulting mixture is labeled lead arsenate and water, the percentage of extra water being plainly and correctly stated on the label.

In the case of insecticides or fungicides, other than paris green and lead arsenate: *first,* if its strength or purity fall below the professed standard or quality under which it is sold; *second,* if any substance has been substituted wholly or in part for the article; *third,* if any valuable constituent of the article has been wholly or in part abstracted; *fourth,* if it is intended for use on vegetation and shall contain any substance or substances which, although preventing, destroying, repelling, or mitigating insects, shall be injurious to such vegetation when used.

SEC. 8. That the term "misbranded" as used herein shall apply to all insecticides, paris greens, lead arsenates, or fungicides or articles which enter into the composition of insecticides or fungicides, the package or label of which shall bear any statement, design or device regarding such article or the ingredients or substances contained therein which shall be false or misleading in any particular, and to all insecticides, paris greens, lead arsenates, or fungicides which are falsely branded as to the state, territory, or country in which they are manufactured or produced.

That for the purpose of this act an article shall be deemed to be misbranded—

In the case of insecticides, paris greens, lead arsenates, and fungicides: *first,* if it be an imitation or offered for sale under the name of another article; *second,* if it be labeled or branded so as to deceive or mislead the purchaser, or if the contents of the package as originally put up shall have been removed in whole or in part and other contents shall have been placed in such package; *third,* if in package form, and the contents are stated in terms of weight or measure they are not plainly and correctly stated on the outside of the package.

In the case of insecticides (other than paris greens and lead arsenates) and fungicides: *first,* if it contains arsenic in any of its combinations or in the elemental form and the total amount of arsenic present (expressed as per centum of metallic arsenic) is not stated on the label; *second,* if it contains arsenic in any of its combinations or in the elemental form and the amount of arsenic in water-soluble forms (expressed as per centum of metallic arsenic) is not stated on the label; *third,* if it consists partially or completely of an inert substance or substances which do not prevent, destroy, repel or mitigate insects or fungi and does not have the names and percentage amounts of each and every one of such inert ingredients plainly and correctly stated on the label; *provided, however,* that in lieu of naming and stating the percentage amount of each and every inert ingredient the producer may at his discretion state plainly upon the label the correct names and pecrentage amounts of each and every ingredient of the insecticide or fungicide having insecticidal or fungicidal properties, and make no mention of the inert ingredients, except in so far as to state the total percentage of inert ingredients present.

SEC. 9. That no dealer shall be prosecuted under the provisions of this act when he can establish a guaranty signed by the wholesaler, jobber, manufacturer, or other party from whom he purchased such articles, to the effect that the same is not adulterated or misbranded within the meaning of this act, designating it. Said guaranty to afford protection shall contain the name and address of the party or parties making the sale of such articles to such dealer, and an itemized statement showing the articles purchased; or a general guaranty may be filed with the secretary of the United States department of agriculture by the manufacturer, wholesaler, jobber or other party in the United States and be given a serial number, which number shall appear on every package of insecticide or fungicide sold under such guaranty with the words "guaranteed by" (the name of the guarantor) under the insecticide act of 1910; and in such case said party or parties shall be amenable to the prosecutions, fines, and other penalties which would attach in due course to the dealer under the provisions of this act.

SEC. 10. That the word "person" as used in this act shall be construed to mean both the plural and the singular, as the case demands, and shall include corporations, companies, societies and associations. When construing and enforcing the provisions of this act, the act, omission or failure of any officer, agent, or other person acting for or employed by any corporation, company, society or associatin, within the scope of his employment or office, shall in every case be also deemed to be the act, omission, or failure of such corporation, company, society, or association, as well as that of the other person.

SEC. 11. Every lot, parcel, or package, of commercial insecticides or fungicides or materials to be used for fungicidal or insecticidal purposes, sold, offered, or exposed for sale, within this State, shall be accompanied by a plainly printed label, stating the name, brand, and trademark, if any there be, under which the insecticide or fungicide is sold, the name and address of the manufacturer, importer, or dealer, the place of manufacture, and a chemical analysis, stating the percentages claimed to be therein, of the substance or substances alleged to have insecticidal properties, specifying the form or forms in which each is present, and the materials from which all constituents of the insecticides are derived. All analyses of substances for which methods have been agreed upon by the American Association of Official Agricultural Chemists, are to be made by such official methods. In the case of those insecticides the selling price of which is less than one half cent per pound, said label need only give a correct general statement of the nature and composition of the insecticide it accompanies.

SEC. 12. The manufacturer, importer, agent of, or dealer in any commercial insecticide, or materials used for insecticidal purposes, the selling price of which to the consumer is not less than one half cent (½ cent) per pound, shall, before the same is offered for sale, obtain a certificate of registration from the secretary of the board of regents of the University of California, countersigned by the said university, authorizing the sale of insecticides in this state, and shall securely fix to each lot, parcel, or package of insecticide the word "registered" with the number of registry. The manufacturer, importer, agent, or dealer obtaining such registry shall pay to the secretary the sum of one ($1.00) dollar, to be applied as provided in section 18 of this act; such registration shall expire on the thirtieth day of June of the fiscal year for which it was given; *provided*, the provisions of this section shall not apply to any agent whose principals shall have obtained a certificate of registration as herein provided. Every such manufacturer, importer, agent, or dealer, who makes or sells, or offers for sale, any such substances, under a name or brand, shall file, on or before the first day of July, in each year, a statement, under oath, with the director of the agricultural experiment station of the University of California, stating such name or brand, and stating the component parts, in accordance with the provisions of section 11 of this act, of the substances to be sold or offered for sale, or manufactured under each such name or brand.

SEC. 13. The said director shall annually, on or before the first day of September, take samples in accordance with the provisions of section 14 hereof, of the substance made, sold, or offered for sale, under every such name or brand, and cause analyses to be made thereof in accordance with the provisions of section 11 hereof, and said analyses may include such other determinations as said director may at any time deem advisable. Dealers in or manufacturers of insecticides must give free access to the director of the agricultural experimnt station, or his duly authorizd deputy, to all materials which they may place on the market for sale in California. Whenever the analysis certified by the said director shall show a deficiency of not more than five per cent of the substance alleged to have insecticidal properties, the statement of the manufacturer or importer, as required in section 11 of this act, shall not be deemed to be false in the meaning of this act; *provided*, that this act shall not apply to sales of insecticidal materials made to a registered manufacturer of insecticides or to sales for export outside of this state; *provided further*, that the said director of the agricultural experiment station of he University of California shall, upon the receipt of a sample of insecticide, accompanied with a nominal fee of one dollar furnish to the user of said commercial insecticide such examination or analysis of the sample as will substantially establish the conformity or non-conformity of the said insecticide to the guarantee under which it was sold.

SEC. 14. The director of the agricultural experiment station of the University of California, in person or by deputy, is hereby authorized to take a sample, not exceeding two pounds in weight for analysis by the said director or his deputies, from any lot, parcel or package of insecticide or fungicide, or material, or mixture of materials used for insecticidal or fungicidal purposes, which may be in the possession of any manufacturer, importer, agent or dealer; but said sample shall be drawn in the presence of said party or parties in interest, or their representatives. In lots of five tons or less, samples shall be drawn from at least ten packages, or, if less than ten packages are present, all shall be sampled; in lots of over five tons, not less than twenty packages shall be sampled. The samples so drawn shall be thoroughly mixed, and from it two equal samples shall be drawn and placed in glass vessels, carefully sealed and a lebel placed on each, stating the name or brand of the insecticide or material sampled, the name of the party from whose stock the sample was drawn, and the time and place of drawing; and said label shall also be signed by the said director or his deputy making such inspection, and by the party or parties in interest, or their representatives present at the drawing and sealing of said samples. One of said duplicate samples shall be retained by the party whose stock was sampled, and the other by the director of the agricultural experiment station of the University of California.

SEC. 15. The director of the agricultural experiment station of the University of California shall publish in bulletin form, from time to time, at least annually, the results of the analyses, hereinbefore provided with such additional information as circumstances may advise.

SEC. 16. There is hereby provided for carrying out the purposes of this act, out of any moneys in the state treasury not otherwise appropriated, the sum of five thousand dollars for each fiscal year hereafter, beginning with the first day of July, 1911.

SEC. 17. All persons charged with the enforcement or execution of any of the provisions of this act shall not directly or indirectly be interested in the sale, manufacture or distribution of any insecticide or fungicide affected by this act.

SEC. 18. All moneys, whether receved from registry and analytical fees or special license fees shall be paid to the secretary of the board of regents of the University of California for the use of said board in carrying out the provisions of this act.

SEC. 19. An act to prevent fraud in the sale of paris green used as an insecticide, chapter LIII, page 69, Statutes of 1901, is hereby repealed.

SEC. 20. This act shall take effect and be in force from and after July 1, 1911.

QUARANTINE ORDER NO. 7.

SACRAMENTO, December 23, 1911.

(POTATO EELWORM.)

WHEREAS, We have reason to believe that several districts more or less restricted in area, in the three counties of Nevada, viz.: Lyon, Churchill, and Washoe, which, on November 27, 1911, were quarantined against the potato eelworm, are free from this pest and ought not in justice to the growers and to our people, as well, be denied entrance to California; and

WHEREAS, It is impracticable to exclude said districts from the quarantine; therefore,

Resolved, That we declare the said quarantine revoked and permit all potatoes from Nevada to enter this State, but all such potatoes must be carefully inspected upon arrival and if a single potato is found to harbor the eelworm, the entire car will be ordered out of the State or destroyed, at the option of the shipper.

A. J. COOK,
State Commissioner of Horticulture.

Approved:
HIRAM W. JOHNSON,
Governor of State of California.

QUARANTINE ORDER NO. 8.

SACRAMENTO, January 25, 1912.

(TULARE COUNTY.)

WHEREAS, Quarantine Order No. 3, Tulare County, California, only permitted fruit to be delivered at Porterville, Lindsay, Exeter, Tulare, Visalia, Ducor, Dinuba, Cutler, Pixley, Angiola, and Terra Bella as other railroad stations of the county are without agents; and

WHEREAS, Strathmore, Sultana, Tipton, Goshen, and Farmersville now have agents at each of these places; therefore,

It is declared that all the stations named above be places for delivery of nursery stock, fruit trees, fruit and plants, and which, if found free from insects or disease, will be released by the deputy quarantine officer of said county.

A. J. COOK,
State Commissioner of Horticulture.

Approved:
HIRAM W. JOHNSON,
Governor of State of California.

QUARANTINE ORDER NO. 20.

SACRAMENTO, February 27, 1913.

(ALFALFA WEEVIL.)

Quarantine Order No. 16, under date of October 15, 1912, is hereby amended to rear as follows:

WHEREAS, Alfalfa fields in the states of Utah, Wyoming and Idaho and infested with the alfalfa weevil (*Phytonomus posticus*); and

WHEREAS, The devastation of this insect is very serious, often ruining the entire crop; and

WHEREAS, Our alfalfa product is very important, its estimated cash value for the present year being a little short of $50,000,000; and

WHEREAS, There is danger of our receiving this pest through the importation of all kinds of hay, including alfalfa from the aforesaid states; and

WHEREAS, It is a menace to the interests of California alfalfa growers to introduce either nursery and ornamental stock or other plants from the states aforesaid if packed in tule, hay or straw, or shipped in boxes or cars that have not been disinfected; therefore, it is hereby

Ordered and declared that a quarantine be, and is, hereby established against the importation into California of colonies of bees in hives, all hay, including alfalfa and other hay and straw in cattle cars from the states of Utah, Wyoming and that portion of Idaho bounded as follows: On the north by the 43d parallel north latitude, on the east by the State of Wyoming, on the south by the State of Utah, on the west by the 113th meridian west longitude and on the northwest by the Snake River in the State of Idaho. All state quarantine guardians and deputies of the State Commissioner of Horticulture are hereby instructed and required to refuse admission into the State of California of all colonies of bees in hives and all hay from the said quarantined states. If such hay and colonies of bees in hives be shipped into the State in violation of this order they must at once be destroyed or returned to the shipper as required by law; it is hereby further

Ordered and declared that all nursery and ornamental stock and other plants imported into the State of California from the aforesaid states of Utah, Wyoming and portions of Idaho must be packed in fresh shavings, excelsior or other suitable packing (excepting tule, hay and straw), and the box containers and cars must be disinfected by fumigation with chemically pure cyanide of potassium, using three ounces to each one hundred cubic feet of space, such fumigation to be given both at the point of shipment and at the point of delivery. Every lot of said nursery and ornamental stock or other plants from the infested states must be shipped either to a quarantine officer of the State of California or to a quarantine guardian or other person authorized in writing by the State Commissioner of Horticulture to receive it; and every lot of such nursery and ornamental stock or other plants must be delivered at such freight or express office as shall be designated by said state quarantine officer, quarantine guardian or other authorized person, and held by him in quarantine and fumigated as provided for above. All expense incurred in treating for disinfections of such lot of nursery and ornamental stock or other plants shall be paid by the consignee or owner, and the nursery and ornamental stock or other plants shall not be released until the same is paid; and it is hereby further

Ordered and declared that no alfalfa seed from the infested states shall be received into California except upon compliance with the following conditions: Every lot of alfalfa seed from the infested states must be enclosed in a container sufficiently tight to prevent the egress of any alfalfa weevils, should any be enclosed, and must be shipped either to a quarantine officer of the State of California or to a quarantine guardian or other person authorized in writing by the State Commissioner of Horticulture to receive it; and every lot of such seed must be delivered at such freight or express office as shall be designated by said state quarantine officer, quarantine guardian or other authorized person, and held by him in quarantine and sufficiently treated until in his judgment the lot should be released. All expense incurred in treating for disinfections of such lot of alfalfa seed shall be paid by the consignee or owner, and the alfalfa seed shall not be released until the same is paid.

A. J. COOK,
State Commissioner of Horticulture.

Approved:
HIRAM W. JOHNSON,
Governor of State of California.

QUARANTINE ORDER NO. 21.

SACRAMENTO, March 4, 1913.

(CITRUS WHITE FLIES.)

Quarantine Orders No. 15, under date of August 30, 1912, and 18, under date of December 17, 1912, are hereby amended to read as follows:

WHEREAS, The fact has been determined by the State Commissioner of Horticulture that the white fly (*Aleyrodes citri*) is widely distributed in the states of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana and Texas, and that the white fly (*Aleyrodes nubifera*) exists at the present time in the State of Florida; and

WHEREAS, Both *Aleyrodes citri* and *Aleyrodes nubifera* are primarily serious pests of, and work great injury to, citrus trees; and

WHEREAS, There is great danger of introducing *Aleyrodes citri* and *Aleyrodes nubifera* into the citrus groves of California by the importation of such plants, trees or ornamental nursery stock as are known to be hosts or food plants of any or all species of citrus white flies from each of the states aforesaid. Now, therefore, it is hereby

Ordered, directed and declared, that a horticultural quarantine be, and the same is, hereby established in accordance with the provisions of Section 2319-*b* of the Political Code of the State of California, against all the known host plants of *Aleyrodes citri* and *Aleyrodes nubifera* as follows:

Allamanda (*Allamanda neriifolia*)
Banana shrub (*Magnolia fuscata*)
Boston ivy (*Ampelopsis tricuspidata*)
Citrus (Orange, lemon, citron, grapefruit, kumquat, tangerine and all other citrus plants)
Cape jessamine (*Gardenia florida*)
Cape jessamine (*Gardenia jasminoides*)
California privet (*Ligustrum amurense*)
Cherry laurel (*Prunus laurocerasus*)
Cultivated pear (*Pyrus sp.*)
Crape myrtle (*Myrtus lagerstrœmia*)
China berry (*Melia azedarach*)
Coffee (*Coffea arabica*)
English ivy (*Hedera helix*)
Ficus macrophylla
Golden privet (*Ligustrum* sp.)
Green ash (*Fraxinus lanceolata*)
Japanese persimmon (*Diospyros kaki*)
Jasminum fruticans
Laurestinus (*Viburnum tinus*)
Lilac (*Syringa vulgaris*)
Mexican orange (*Choisya ternata*)
Mock olive (*Prunus caroliniana*)
Myrtle (*Myrtus communis*)
Osage orange (*Maclura aurantiaca*)
Portugal cherry (*Cerasus* sp.)
Pomegranate (*Punica granatum*)
Prickly ash (*Xanthoxylum clava-herculis*)
Smilax (*Smilax* sp.)
Texas umbrella (*Melia azedarach* var. *umbraculiformis*)
Tree of Heaven (*Ailanthus glandulosa*)
Trumpet vine (*Tecoma radicans*)
Water oak (*Quercus aquatica*)
Wild persimmon (*Diospyros virginiana*)
Wild olive or devilwood (*Osmanthus americanus*)
Yellow jessamine (*Jasminum odoratissimum*)

or any other that may hereafter become a host plant, imported from the states of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana and Texas, or any other section known to harbor either *Aleyrodes citri* or *Aleyrodes nubifera*, into the State of California. All quarantine guardians and deputies of the State Horticultural Commissioner are hereby instructed and required to hold any and all of the aforesaid host plants, nursery and ornamental stock, which are host plants of this *Aleyrodes citri* and of this *Aleyrodes nubifera*, subject to the order of the shippers or owners thereof for exportation out of the state, or to be destroyed, and to take every necessary precaution for the prevention of the issuance of the said white flies while the same are being held in quarantine.

Provided, that all plants, nursery and ornamental trees, other than the host plants enumerated in this order, (excepting coniferous species) imported into the State of California from the aforesaid states of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana and Texas, or any other section known to harbor either *Aleyrodes citri* or *Aleyrodes nubifera*, or both, shall be completely defoliated and failure upon the part of the shippers or importers to comply with this ruling shall result in the holding of such shipment by the state quarantine authorities, subject to return or destruction at the discretion of the shippers or importers. And, it is hereby further

Provided, that orange seed and fruit pits may be received into the State of California upon compliance with the following conditions: Every lot of orange seed or fruit pits brought into the State of California from North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana and Texas, or other territory infested with either *Aleyrodes citri* or *Aleyrodes nubifera*, or both, must be enclosed in a container sufficiently tight and secure to prevent the egress of these pests, should any be enclosed; and every lot of such orange seed or fruit pits must be shipped to the Deputy Quarantine Officer of the California State Commissioner of Horticulture in Los Angeles or to any other person authorized in writing by the State Commissioner of Horticulture to receive it. Every such lot must be delivered at such freight or express office as shall be designated by said Deputy Quarantine Officer, or any other authorized person, and held by him in quarantine and sufficiently treated until in his judgment the lot may be released. All expense incurred in treating for disinfections of such lot of orange seed or fruit pits shall be paid by the consignee or owner, and the orange seed or fruit pits shall not be released until the same is paid.

A. J. COOK,
State Commissioner of Horticulture.

Approved:
HIRAM W. JOHNSON,
Governor of State of California.

QUARANTINE ORDER NO. 19.

SACRAMENTO, January 31, 1913.

(COTTON BOLL WEEVIL.)

WHEREAS, The growing of cotton has become a very important industry in this state, and the area of cotton culture is rapidly growing in extent; and

WHEREAS, The cotton boll weevil (*Anthnomus grandis* Boh.) does not, nor ever has, existed in this state; and,

WHEREAS, The cotton boll weevil (*A. grandis* Boh.), while not attacking the seed of the cotton plant, may hibernate in small deformed bolls and in cells which are very difficult to distinguish from the cotton seeds by inspection, or may be, and is carried in the mass of cotton seed and is not separated from the cotton seed by the process of ginning; and,

WHEREAS, According to the authorities of the United States Department of Agriculture, proper fumigation for the destruction of the cotton boll weevil (*A. grandis* Boh.) in cotton seeds is a very difficult process, requiring special equipment and skilled manipulation; and,

WHEREAS, The cotton growers of California now have a sufficient supply of home-grown seed for all practical purposes; therefore, it is hereby

Ordered and declared that there be placed a quarantine upon all cotton seed shipped into California from any section whatsoever, except as hereinafter stated. That cotton seed be admitted for experimental purposes, the same to be sent to the Chief Deputy State Quarantine Officer, Room 11, Ferry Building, San Francisco, California, to be thoroughly examined, treated and reshipped to the purchaser; it is hereby further

Ordered and declared that Quarantine Order No. 2 be revoked.

A. J. COOK,
State Commissioner of Horticulture.

Approved:
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Governor of the State of California.

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VOLUME II Nos. 3 and 4

THE MONTHLY BULLETIN

PROCEEDINGS

OF THE

FORTY-SECOND CALIFORNIA

State Fruit Growers' Convention

Held under the auspices of the State Commission of Horticulture, at

CITY HALL
FRESNO CALIFORNIA
December 11, 12, 13, 1912

OF

STATE COMMISSION OF HORTICULTURE

SACRAMENTO, CALIFORNIA MARCH AND APRIL, 1913

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STATE COMMISSION OF HORTICULTURE

March and April, 1913

THE MONTHLY BULLETIN

VOLUME II Nos. 3 and 4

DEVOTED TO THE DESCRIPTIONS, LIFE HABITS AND METHODS OF CONTROL OF INSECTS, FUNGOID DISEASES AND NOXIOUS WEEDS AND ANIMALS, ESPECIALLY IN THEIR RELATIONS TO AGRICULTURE AND HORTICULTURE.

EDITED BY THE ENTIRE FORCE OF THE COMMISSION UNDER THE FOLLOWING DIRECTORS:

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1913

PROCEEDINGS OF FORTY-SECOND CALIFORNIA STATE FRUIT GROWERS' CONVENTION.

December 11 to 13, 1912.

FIRST DAY—MORNING SESSION.

Fresno, California, December 11, 1912.

The convention was called to order by Dr. A. J. Cook, State Commissioner of Horticulture.

Mr. E. O. Essig, secretary of the State Commission of Horticulture, acted as secretary.

Miss L. A. Cauthard acted as official stenographic reporter.

Dean G. R. E. McDonald of Fresno opened the meeting with an invocation.

President Cook. We will now have the address of welcome by the mayor of the city of Fresno, Hon. Alva E. Snow.

ADDRESS OF WELCOME.

By Mayor Alva E. Snow, Fresno.

I want to say to you that conventions of the state fruit growers mean a great deal to every community where such conventions are called. The benefits to be derived from them are not confined to the particular locality where such a convention is held, but is state-wide. This locality, comprising as it does a large territory practically in the center of the State of California, and having greatly diversified fruit orchards, is especially interested in this convention, and when I see such subjects as are printed in this programme to be discussed by such men as you have selected therefor, we consider ourselves especially favored.

The benefits, however, to be derived locally from this convention will not be confined, I assure you, Mr. Chairman, to those people who are fortunate enough to attend any and all of your sessions, but your doings and sayings here will be spread generally throughout the county by means of our Fresno press and read with great profit and interest by our citizens. I hope while you are here you will be able to take the time to visit our extensive vineyards, orange and lemon groves and orchards. They are very extensive and will interest you.

By the time your convention is over I hope our State Commissioner will have devised some means of exterminating all the bugs in this community. The people of this county a short time ago assisted in this respect, or to some extent at least, by their votes in exterminating all the "bug juice" outside of the incorporated town.

There is a bug that was let loose in this community about two months ago, which we have nourished very carefully. It has become very prolific; it has spread as far as Tulare in this short time and is making rapid strides, I understand, toward Bakersfield on the south; and on the north, I am told, its eggs are already deposited in Sacramento. That, Mr. Chairman, ladies and gentlemen, is the public market. I hope you will take time to see it. It holds its next convention tomorrow morning and will be in session before you convene. I think it will interest you all, and you are invited to inspect it.

Now, Mr. Chairman, ladies and gentlemen, I take great pleasure in bringing to you a most hearty welcome to our city of Fresno. I hope that your sojourn here will be as pleasant and profitable to you as it will be to us.

Chairman Cook. *Mr. Mayor, Ladies and Gentlemen of the California State Fruit Growers' Convention:* It is indeed a great pleasure to respond to such a gracious welcome as we have just received. Fresno is noted for its generous hospitality, and we were sure of a hearty reception, which is now emphasized by the warm welcome by the mayor.

Previous Convention.

I was here at Fresno at a previous convention under the able direction of our esteemed predecessor, Hon. Elwood Cooper. Then, as now, the good people of this beautiful city were most cordial in their welcome and as lavish in their entertainment.

Fresno.

I heard an able address from President Wheeler the other day at the dedication of the new Agricultural Hall of our great University. Among other good things he spoke of a possible annex of the University here at Fresno, when would be established a summation of culture, practical and disciplinary, which would be a real roundup of university benefaction. That will likely be at Kearny Park, at the farther end of the wonderful boulevard which I hope we shall all enjoy on the morrow.

June Convention. Review of Work.

At the June convention I gave a brief resumé of the work of the State Horticultural Commission for the first year. I have a word to add at this time.

Mediterranean Fruit Fly.

Upon our return to Sacramento in June we made the most of the resolutions passed by the county horticultural commissioners, sending night messages to all our Congressmen and to the horticultural officers of other states. I believe that by this action, the admirable service of Dr. C. L. Marlatt and the unflagging, insistent pushing by our Congressmen, especially Congressman William Kent, each and all we are indebted for our great victory in securing the invaluable national quarantine law, which will be a great aid, not only in our control of the Mediterranean fruit fly, but also in protecting against other noxious insects and fungous pests. We are all to be felicitated in that we have kept that arch enemy, the alfalfa weevil, and several other serious insect pests from entering California.

Alfalfa Weevil.

The desire of the county horticultural commissioners as expressed at the Santa Barbara convention regarding more strenuous quarantine orders against the white fly has been granted, and a more stringent extended order has been declared against the alfalfa weevil. A new order has now been declared, including nursery stock from the states where this alfalfa weevil is known to exist.

Two Important Laws.

With the Hawaiian and National quarantine laws we are much better protected than heretofore, and I believe we may feel quite secure, as I think we may keep our orchards at their best, which means the finest in the world.

County Ordinances.

We have a ruling from the Attorney General that our county quarantine ordinances are right and proper in case they infringe no State laws. Their enforcement, however, can not be left to the county horticultural commissioners, but must be carried to the courts. If thought desirable, the law could be so amended as to give the county horticultural commissioners authority to enforce any such ordinance.

Change of Present Law.

There is a suggestion that was made at the recent State Nurserymen's Association to change the law, making the county horticultural commissioners state officers, under the State Horticultural Commissioner, so as to make quarantine action and control measures more uniform. They would then cease to be county officers. I would urge the fact that our horticultural laws are now working well, our county horticultural commissioners are able and alert, and their work is increasingly efficient. I greatly question the advisability of making any decided changes in our law. The change referred to above would, I believe, be inopportune at the present time. A not very important but convenient measure would be secured by a change of the law making any one who has passed an examination in any county as a candidate for county horticultural commissioner eligible in any other county of the State.

Crop Reports.

We hope our crop reports and orchard statistics may be required by law of the several county horticultural commissioners. They are now required by the State Commissioner of Horticulture. These crop reports are greatly appreciated and will more and more be considered a great asset of the State.

White Fly.

You will all be pleased to learn that we have made a sustained warfare against the white fly at Marysville. We have sprayed once and fumigated twice at a considerable expense. I feel that we must extirpate this pest at any cost. Can we afford to tolerate such a menace within the confines of the State?

Lectures.

As soon as I took office, in obedience to the law, I commenced to lecture in the various towns and counties as time and opportunity permitted. I have now addressed over fifty audiences in thirty different counties. I am very glad to do this, as it enables me to acquaint myself with the needs, resources, and possibilities of the several counties of the State and to come into closer touch with the county horticultural commissioners and the many horticulturists of the State.

The Commission of Use.

I wish again to invite most heartily all of you to use the office of the State Horticultural Commissioner. There is no place in the country where you can get such prompt, accurate, and helpful information as with us. We have now a large, accurately-named, systematic collection of insects which enables quick identification and practical advice. We are also now equipped to give practical aid regarding the many fungoid troubles that will more and more strike at the best interests of the fruit growers.

You can help us greatly by collecting and sending to us fifty or more specimens of any insect that attracts attention, either as a friend or enemy. Such action on your part will not only greatly add to our collection at Sacramento, but will make us able to build up for each county horticultural commissioner a collection that will greatly aid him in his service to the public.

Chairman Cook. W. H. Volck will now address the convention on "The Control of Red Spiders."

THE CONTROL OF RED SPIDERS.

By W. H. Volck, Watsonville, Cal.

The various kinds of mites which attack cultivated plants are at times responsible for considerable damage to crops. In California we have three important species which are frequently troublesome, namely, the citrus red spider (*Tetranychus mytilaspidis*), the yellow mite (*Tetranychus bimaculatus* Harvey) and the almond red spider (a species of *Bryobia*). These mites, while commonly thought of as insects, are really more closely related to the spiders. The species just mentioned are all very minute, being scarcely visible without a lens; but their ability to multiply at a very rapid rate makes them capable of inflicting much damage. The citrus red spider may pass through sixteen generations in a year, and each female can produce thirty to sixty individuals. Often, the greater portion of these will be females. Thus, in nine weeks, the offspring of one mite can be upward of 1,800 individuals. Reproduction is by means of eggs which hatch whether fertilized or not, the only difference being that the unfertilized eggs produce males, while all fertilized embryos appear to develop into females.

The eggs are laid on the surface of the plant, especially along the midribs of the leaves, on both surfaces. The young mites feed constantly, except when moulting, and the process of feeding consists in sucking the juice from the outer layer of cells on the leaves and fruit. But little mechanical injury is done, and badly discolored leaves may recover if the mites are removed. Continued infestation results in a much faded and browned foliage, and even partial defoliation. The fruit also loses color as if put through a process of bleaching.

The almond red spider behaves in much the same way, differing most in production of winter eggs, which may remain on the trees from midsummer to the following spring before hatching. Frequently these eggs are so numerous as to produce red patches on the twigs and branches where they have been laid. This mite may produce more rapid and serious injury than the citrus species, and is often responsible for crop failures. The almond mite feeds quite generally on deciduous trees, but develops most readily on almonds. It is apparently confined to such fruit trees and can not be bred on clovers, as its scientific name implies. It is a difficult species to rear under artificial conditions, so its habits are less well known than those of the other species treated in the paper.

The yellow mite (*Tetranychus bimaculatus* Harvey), is more nearly related to the orange red spider. Its life history is much the same, and has been well worked out, with the exception of the method of wintering over. Our present state of knowledge indicates that this is accomplished through hibernating of very slightly active females. This mite feeds on many kinds of plants, including annual crops, and in fact does its greatest damage to some, such as hops. It also attacks strawberries, and is found on numerous weeds. Fruit trees are not exempt, and when attacked are greatly injured. The most evident distinguishing character of a yellow mite infestation is the presence of considerable very fine cob web, covering the foliage.

Methods of Control.

Many interesting things could be said about the habits and life history of these mites, but the purpose of this paper is the discussion of control methods. The first investigation of a red spider problem in this State was that conducted by the State University in southern California in 1902, and dealing with the orange species. This investigation developed the fact that the citrus red spider was very sensitive to sulphur, and might be readily controlled.

If sulphur particles were well distributed over the foliage, and retained in place by any suitable means, a long continued action resulted, which killed, not only those mites present at the time of spraying, but also any hatching from eggs. This was an important advantage over the then existing treatment, which consisted in spraying with a dilute solution of sodium sulfide. This treatment sufficed to kill only those mites present at the time of spraying and left the eggs to hatch, a condition which demanded spraying at intervals of three weeks until natural conditions became unfavorable to the red spiders.

Dusting with sulphur has also been resorted to, but gave poor results, owing to the failure in distribution and adhesion. For these reasons the sulphur was mechanically mixed with water, to which had been added some flour paste, and the trees thoroughly sprayed in such a manner as to wet both surfaces of the leaves. This mixture proved entirely successful, completely controlling the citrus red spider at any season of the year. However, in this, as well as in most other matters, prevention is preferable to cure, and makes the proper timing of the spraying important. In this connection, it has been demonstrated that under southern California conditions, spraying in August will render orange and lemon orchards immune for the year.

In actual practice, the sulphur-flour paste formula has not been as much used as its merits justify, but resort has been had to spraying with sulphur solutions. While these solutions kill by contact, as has been explained, they do not have sufficient lasting effect. Such sulphur solution as lye-sulphur and lime-sulphur will prove injurious to foliage if used at all strong. The high dilution necessary to prevent injury will leave so little sulphur deposited after the water has evaporated that the young mites may not be killed when they hatch a week or ten days later. The practice of using lime-sulphur solution could be much improved by adding a few pounds of sublimed sulphur to each tank, provided, of course, that there is sufficient agitation to keep it uniformly mixed. Finally, the use of flour paste is doubly advisable, as will appear later.

In 1903, the writer was sent to Sutter County to investigate a very refractory case of almond red spider infestation. The usual practice of dusting with sulphur had proved absolutely worthless, for reasons which are not fully understood. This infestation yielded to the sulphur-flour paste mixture, although some lye-sulphur solution was added to give quicker results on the adult mites, which were present in enormous numbers. As with the citrus red spider, proper timing of the application is important. The spraying should be done before much injury has developed. This will be shortly after blooming, when enough foliage has grown to hold the spray well.

Another method of treatment appears to give promise with the almond mite. That is winter spraying with crude oil emulsion. Such deciduous trees as are injured by this red spider are frequently in need of some winter spraying to kill moss and scale. Also, there appears to be great possibilities in the way of stimulation by the use of oily winter sprays. So marked are the stimulating effects of crude oil emulsion that I predict considerable use of it, or some similar material, for that purpose alone. It happens that the crude oil spray is also capable of killing red spider eggs, and a marked degree of control has already been observed as a result of such spraying.

The almond mite should not be dismissed without some discussion of the dusting method of control, for very marked benefit has been obtained by the use of dry sulphur.

Some kind of a blowing machine is needed for this work, and it is best to use a mixture of hydrated or fine lime dust as a diluent for the sulphur. The first dusting should be applied early in the spring, shortly after blossoming, this to be followed in three to four weeks by a second application; more dustings to be applied if it proves necessary.

The Yellow Mite.

The year following the experiments with the almond red spider (1904), I applied the sulphur-flour paste sulfide of soda mixture to hops at Wheatland in an effort to control the yellow mite (*Tetranychus bimaculatus* Harvey). This experiment did not prove successful, as it was found the species in question resisted the action of sulphur almost completely. This resistance is so marked that the mite can develop when foliage, well covered with sulphur, was enclosed in paper bags and exposed to the high temperature of that locality.

Some years later (1911), W. B. Parker, agent, engaged in truck crop and stored products insect investigation, Bureau of Entomology, U. S. Department of Agriculture, was more successful in the control of this mite by the use of a dilute lime-sulphur solution containing flour paste. In this case the paste was used to increase the covering or wetting power of the spray. The killing with this mixture is entirely a matter of contact, and the application may require repeating two or three times for continued control.

It appears then that a double advantage has been demonstrated for the use of flour paste in spray materials intended for the control of mites; not only may particles of solid sulphur be made to adhere firmly to the foliage, but the wetting power of the spray will be greatly increased.

Natural Control of Red Spider.

Most species of mites (especially the citrus and almond red spiders) are subject to very marked and rapid reduction in abundance as a result of natural causes, including predaceous insects, parasites, and climatic conditions. It frequently happens that the man who sprays his orchard at the time when the red spider attacks look the worst, will not come out much better than his neighbor, who does nothing. Such experience should not, however, be taken as an argument in favor of the do-nothing policy, but on the other hand, they do argue strongly in favor of timing the treatment so as to have preventive effect; that is, spraying before the mites have become numerous, in order to prevent them from becoming so.

Spray Formulas.

The original flour paste-sulphur formula is prepared as follows: Mix wheat flour with water at the rate of one pound to the gallon, and heat to the boiling point. The paste so formed will be quite free from lumps, if the flour has been properly mixed with the cold water. This can be done by washing it through a box with a window screen bottom.

The stock paste solution so formed is used at the rate of four gallons to 100 gallons of water in the spray tank. To this diluted mixture may be added sublimed sulphur or a sulphur solution. or both. Sublimed sulphur may be used at the rate of 5 to 10 pounds to the 100 gallons. The 5-pound mixture is sufficiently strong if the spraying is done properly.

Sulphur solutions may be used at the rate of 1 to 6 pounds of sulphur (in the form of poly sulfides) to the 100 gallons. A good formula for both citrus and almond red spider may thus be made up:

Water	100 gallons
Flour paste	4 gallons
Sublimed sulphur	5 pounds
36-degree lime-sulphur solution	1 gallon

Thorough agitation is necessary to keep to sulphur in uniform suspension. Parker recommends this formula, minus the sublimed sulphur, for yellow mite on hop. Commercial lime-sulphur solution is now readily obtainable. It is more convenient to use than the lye-sulphur formula, so that material will not be discussed here.

Iron Sulfide.

Sublimed sulphur is at best a coarse material. A much finer form of sulphur is produced by precipitation of lime-sulphur solution with copperas (iron sulfate).

Water	100 gallons
Flour paste	4 gallons
Lime-sulphur solution	5 quarts
Copperas (iron) sulfate	2 pounds

Add the solution of copperas to the fully diluted mixture in the spray tank, with proper agitation.

This formula will be found very satisfactory for treating the almond red spider on various deciduous trees, and may be used on oranges for the August spraying, or after the fruit is picked. If applied too near picking time, the fruit may be stained.

Sulphur Injury.

In some cases foliage may be injured even by very dilute sulfide solutions. Peach trees have at times shown a high degree of sensitiveness. In cases where injury developes the lime-sulphur should be much reduced in strength or eliminated entirely. In the iron sulfide formula the lime-sulphur solution may be reduced to three quarts, or the commercial material can be used, in which case both lime-sulphur solution and copperas are omitted. Also, the sublimed sulphur formula just given, with lime-sulphur solution omitted, will be found satisfactory. Commercial iron sulfide should be used at the rate of 6 to 12 pounds to the 100 gallons.

Crude Oil Emulsion.

The crude oil winter spray intended for use on all deciduous trees, while dormant, is readily prepared according to this formula:

Water	175 gallons
Lye (caustic soda)	4 pounds
Soap oil (oelic acid)	1 gallon
Crude oil	25 gallons

Place in the spray tank in the order mentioned, with agitation in motion. Warm the soap oil if it is not thoroughly liquid. In place of the oelic acid, in case it can not be obtained, use 20 pounds of whale-oil soap. Very hard water may require more soap.

This formula should convert the crude oil into a brown colored emulsion, which is easily agitated to a uniform mixture.

Dusting Mixture.

A good material for use in dusting machines is prepared as follows:

Hydrated lime	100 pounds
Sublimed sulphur	20 pounds

Apply very thoroughly so that the trees will show a good coating of the powder.

Nicotine in Red Spider Sprays.

While nicotine is not very effective against mites, its use in red spider sprays may at times be advisable to control aphids. In such cases "Black Leaf 40" may be added to any of the liquid formulas at the rate of 1 pound to 100 gallons.

CHAIRMAN COOK. Mr. Volck has had a great deal of experience in this matter and will be glad to answer any questions in regard to same. Has any one any questions to ask?

A MEMBER. Do the red spiders multiply according to the condition of the weather?

MR. VOLCK. Yes, but just what those are would be difficult for me to say. Those conditions are not exactly known. I may say that at times it is a little too warm, at times a little too dry, or may be at other times it may be just right; that has not been fully determined. You know in some cases they grow much better under protection than out under natural conditions, and frequently they are worse in greenhouses than other places, and they will readily develop on moist soil or soil that has been under some sort of cover, such as a paper bag, showing that the external climatic conditions in California are not favorable. The same is true of many insects. The almond mite develops better in the warm interior sections than along the coast, and the same is true of the citrus red spider.

A MEMBER. Are the red spiders migratory? Do they come and go?

MR. VOLCK. No, they are not migratory, but usually remain in one place, excepting when the food supply runs out they will go somewhere else.

A MEMBER. Why are red spiders more numerous along roadsides than in orchards?

MR. VOLCK. I do not know as I have any satisfactory explanation for that. I always thought that it might be due to the influence of dust settling on the trees, but I couldn't say that this has anything to do with it.

MR. SCHULZ. When is the best time to spray for the citrus red spider?

MR. VOLCK. I do not know about all parts of the State—about how often they should be applied in the Sacramento and San Joaquin valleys, but in the southern part of California, the proper time to spray for the citrus red spider is in the month of August. Use sublime sulphur with flour paste, and you can also use the lime-sulphur solution, if you wish.

MR. CHAPMAN. You say to spray before they come; how are you going to tell when they are coming? We can't go out and find out about these things. When they appear won't it be time to go after them?

MR. VOLCK. That is an entirely wrong way; spray regularly in your orchard; go over the ground very carefully with your sprays.

MR. CHAPMAN. You know that is impracticable.

DR. COOK. When I came from Michigan about twenty-five years ago the people were just commencing to spray for certain fungous diseases and troubles there. Now and then they would spray, waiting until there were evidences of attack, then they would spray; but that caused great trouble and now they don't hesitate, they spray every year. I agree with Mr. Volck.

MR. CHAPMAN. Suppose you have red spider only once in five years. Would you go through your orchards and spray every year?

MR. VOLCK. They should be sprayed in advance rather than after the red spider has appeared.

MR. PEASE. Mr. Volck has stated that it does not always appear. Perhaps this year may be bad and next year we may not have trouble at all. Would you spray whether the spider was there or not?

MR. VOLCK. Yes.

DR. COOK. I believe that is the most important thing that will be said at this convention. Mr. Teague of the Limoneira Company spent between five and six thousand dollars last year in firing his orchards for frost protection, and saved thousands on that account.

MR. PEASE. One more question. If we haven't any spiders and there are not very many eggs there, how long will the effect of your spraying last? And suppose it comes later.

MR. VOLCK. One year.

MR. PEASE. Will it kill the eggs?

MR. VOLCK. The young mites will be killed when hatched from the eggs if the application is put on properly.

MR. PEASE. How long will it last?

Mr. Volck. For a year—spray regularly in August and you will keep the red spider under control.

Mr. Pease. I have not had red spider in our locality in August; they appeared in May and dispersed by the end of June.

Mr. Chapman. One more question. Will the red spider after being sprayed be exterminated completely and be introduced again?

Mr. Volck. I do not claim to exterminate anything. There will always be some mites left, and they will have to be sprayed again next year.

Mr. Jones. I would like to ask in regard to the application of dry sulphur dust. Has the temperature anything to do with its effects?

Mr. Volck. Yes, it has considerable to do with it. Along the coast we do not have very good results using dry sulphur on anything.

Mr. Jones. If the weather is warmer, then it is more effective. Is that right?

Mr. Volck. Yes.

Mr. Cundiff. Can't you control the red spider with dry sulphur much cheaper than with the liquid spraying with one application? Isn't it cheaper than with liquid?

Mr. Volck. You might, but it won't control nearly so completely as the liquid; the dust application put on in August will have little material effect in January or February.

Mr. Cundiff. We absolutely control it in our section with one application, put on much earlier, using a large machine, which dusts it thoroughly over the trees, and it can be done for one eighth the expense per application of the flour paste application. We use both.

Mr. Jones. What kind of sulphur do you use.

Mr. Volck. Best made of sublime sulphur.

Mr. Pease. In using dry sulphur, don't you always depend upon the heat for sticking, for making the sulphur fumes?

Mr. Volck. The essential difference between dry sulphur and sulphur liquid spray is that you get better adhesion with the liquid spray and your material remains longer on the tree. Sulphur dusting has to be effective within a short time after it is applied, for rains and winds shake it off the tree; whereas if put on with flour paste it sticks there and stays for months.

Chairman Cook. The next subject will interest you all, I am sure—our laws and the nurserymen. We are favored in having so able a man as is Mr. George C. Roeding to present this subject. I take great pleasure in introducing to you Mr. George C. Roeding—Mr. Roeding.

HORTICULTURAL LAWS AND THE NURSERYMEN.

By Geo. C. Roeding, Fresno, Cal.

Our laws as I understand them are created for the purpose of doing the most good to the greatest number of our people and are not enacted for the benefit or the injury of any of our citizens in the legitimate pursuance of their vocation.

It must be admitted that a business is developed as a result of certain demands which may exist in a community, or as a result of the exigencies of trade which may cause that business to cover a wide scope of territory.

A man engaged in business endeavors to exert his powers and his intelligence to keep abreast of the times and be in touch with those who desire to purchase the product which he may manufacture or produce.

I am going to speak of California first, in the discussion of this subject, for if there is any one state in the Union in which our horticultural development has surpassed in its extent and along modern and progressive lines, it is this most resourceful State of ours. It is due to the intelligence of a certain class of men that these remarkable strides have been made, and I do not think I am making any grave exaggeration when I say that our nurserymen are largely responsible for placing the fruit business on the high plane on which it stands today. It is through their foresight, and their realization of what could be accomplished that they have introduced so many valuable fruits, and ornamental trees and shrubs which has placed California in a class by itself.

The burning question which arises in their minds now, is, shall they go on putting forth the best that is in them to supply fruits; finer and a greater variety of ornamental trees and plants; or will they quit altogether and engage in other pursuits from which they can derive a living without being constantly harassed by laws whose main purport seems to be to throttle them.

It is useless to deny that this is the condition of affairs as they exist to-day, and with every succeeding year they are becoming more drastic in their application.

Every railroad company and every citizen of this State foresees the great possibilities that lie before us, and in attracting immigration to this coast, it is done with the purpose of inducing settlers to buy small tracts of land and develop them, more so in horticultural products than in any other one thing.

Those who have been merely casual observers, are impressed with the fact that our development in horticulture is still in its infancy and that there are great possibilities before us. There are thousands of acres of land in this State open for development, and the strides which are being made in hydroelectric power and in our irrigation systems will eventually bring many of these lands into a high and intensive state of cultivation.

The advancement of our horticultural interests is dependent without a question of doubt on the nurserymen, for they are the only ones who are going to make an effort to introduce new fruits and plants, and propagate them for sale. It is not necessary for me to dwell very much on this subject, for you to understand that the business must bring adequate returns or it can not exist.

It is not going to be my purpose to discuss radical changes in our laws to correct existing evils, in this paper, but rather the application of these laws. This is not an admission that our laws as now administered are satisfactory to the nurserymen of this State, because they are not, and although I am decidedly in favor of having them under state control and so far as it is possible to do so, to have them uniform, this in itself will not correct conditions entirely, for there will always be more or less conflict.

There is no one who will not concede that a nursery business requires the closest application and the most intelligent effort to succeed; then why should it not be accorded the same treatment on the part of our horticultural commissioners as any other branch of the fruit business? The aim of our commissioners seems to be directed solely at the nurserymen, and they are forced to believe that they are the "goats" for every new law and ordinance that is enacted.

It costs money to raise trees, and this in connection with the fact that trees must be grown and started several years in advance of their sale, the nurserymen being compelled to anticipate what the call will be for, increases the cost of his trees to a still greater degree on account of those which must be burned because, as it often happens, they are not in demand. A nurseryman for his own good wants to keep his stock clean and free of pests, and there is no reason for holding up and condemning his stock because an insect or disease may be found on a few of his trees than there would be for holding up a shipment of fruit for the same cause. Counties are drawing lines of demarcation prohibiting the shipment of certain classes of nursery stock between them, without inspection; still there is just as much chance and even more so, in carrying pests on the fruits which pass through on the railroad trains between these counties and no effort is made toward inspecting this fruit, and even if an occasional pest was found on it, it would not be condemned for shipment.

The nurserymen of California are expected to furnish trees true to name, and in order to supply such stock it is necessary to cut their buds from bearing trees, and preferably such trees in an orchard which produce an abundance of fruit of the very best quality. How many of such orchards are there which do not have pests? Even after fumigating and washing the bud sticks, a pest may get established in a nursery in spite of all the precautions that may be exercised to prevent it. Is it right or just that the entire nursery should be condemned for this reason?

The nurserymen are constantly moving their nurseries to new localities, trying as far as possible to get as far away from orchard districts as they can. They seek the very best land in such places with no other purpose than to grow the best of stock and satisfy the demands of their own conscience and their customers, to supply high grade stock.

These are facts which can not be controverted. Why is it then that a nurseryman's stock is held up and whole carloads condemned because a few trees may be found to be diseased? Travel from one end of this State to the other and there is not a single locality in which fruit growing is carried on in which pests and diseases will not be found. I do not think any horticultural commissioner wilfully wants to ruin the business of any nurseryman, but this is what he does when he gives newspaper publicity to the fact that he has found certain pests on a shipment of nursery stock, and even goes so far as to prohibit the shipment of other classes of stock which have never been known to be attacked by this pest.

The horticultural commissioners and nurserymen should work in harmony to hold pests in check, for it is only by following some such plan as this that the nurseries of California can continue to remain in business. There is not a nursery of any consequence that has not pests and diseases to contend with, and if every intelligent effort is being made to hold these diseases in check, drastic ordinances aimed principally at the nursery interests should not be enforced without very careful consideration. A continuance of the course which is now being followed throughout the State will result ultimately in the extermination of the nursery business entirely, which to-day bears a very important part in the upbuilding of our horticultural interests.

A few words relative to interstate shipments: California is fencing herself in against the shipment of all classes of nursery stock from a group of the southern states on account of the white fly, and now Arizona takes a step in the same direction by prohibiting entry of citrus trees and grapevines from California except from certain counties and districts which are supposedly free from the pests mentioned in the quarantine order. Apparently no thought is given to the nurserymen who may have stock growing in these districts. With the stroke of a pen, they are peremptorily prevented from carrying on their business, because their nurseries happen to be within the restricted area.

Why should we be singled out? Why does not the State Commissioner of Arizona prohibit the shipment of California fruit into Arizona except from the favored counties, giving as one of his reasons for this drastic and unreasonable law that Arizona had sufficient fruit of its own to meet its demands and did not need the California product? This is the argument he uses against our citrus nursery stock. Why does our State Commissioner of Horticulture make this law so sweeping in its effect against all classes of nursery stock which the white fly does not attack, when there is just as much possibility of the white fly being introduced in some other articles of commerce as there is on certain classes of nursery stock which the white fly does not attack?

Is it any wonder that nurserymen are driven to exasperation and are inclined to bid defiance to the many unjust and admittedly illegal ordinances that exist in this State, preventing them from making shipments of certain classes of nursery stock absolutely, and without inspection? We do not ask for anything, except that which we are in all justice entitled to. We want inspection and not general condemnation. We want to be accorded the same courtesies that would be extended to others engaged in horticultural work.

A new pest, the alfalfa weevil, is doing an immense amount of damage to the alfalfa fields of Utah and adjoining states. This pest would be a serious menace to the alfalfa fields of California and every precaution should be exercised to prevent its introduction. A movement is already on foot, so I have been given to understand, which has for its sole purpose the prevention of the shipment of nursery stock from Utah. Can any one explain why this is the case? Does this insect infest fruit trees? If there is no proof that it does, why place this one product in the condemned class? There would be far more reason for prohibiting the movement of trains used for passenger traffic and freight service, which pass through the infested section from being allowed to come into California, as there is for making nursery stock bear the responsibilities for the conveying of this pest.

In conclusion, allow me to say that the nurserymen are deserving of just as much consideration as any other branch of our horticultural interests, and it is high time that the tendency to make them the butt for every new regulation, pertaining to the shipment of stock between states and counties, should not be so framed as to make them bear all the burdens for every new pest which springs into existence, and threatens our horticultural interests.

CHAIRMAN COOK. Mr. Roeding, I presume, will be willing to be questioned. I think this is a most important topic, one of the most important that will come up at this convention, because the nurserymen are a great body of benefactors; we owe very much to them, and we must be in accord with them and they must be in accord with us. It seems to me to be very important that we light upon something at this convention that will help us to settle this question. Mr. Roeding is lying awake nights over this, although his appearance does not show it. I hope that this will be a very friendly and cordial discussion, and that we will all try to get at something that will help us.

MR. MERRILL. Mr. Chairman, this is not exactly the question, but I think some people here would be interested in knowing what the county commissioners have to say in their reports on this subject. Twenty-eight counties kept a record of the nursery stock that they inspected last year and of the trees rejected. There were something over eight million trees inspected. This applies only to fruit trees and plants of commercial importance. Of these two hundred and twenty-nine thousand were condemned. Now the dual system of inspection is in force, and out of eight million inspected trees, two hundred and twenty-nine thousand condemned, it doesn't seem to me to be such a very great loss.

One single shipment of ten thousand trees came from Missouri and was refused admittance.

Mr. Vaile. There are two points I want to add to this discussion. The first one I will illustrate by telling a little story. A few years ago a friend of mine went to one of the largest citrus nurseries in southern California, a nursery which is known for its reliable stock, to get some trees. He found only a few trees left in the stock for delivery of that year. Those trees were very poor trees according to our estimation. The leaves on some of them had fallen off, and some were yellow, and the trees looked very "bum," to use that expression. We asked the nurseryman if he really expected to sell those trees at first class prices, as he was asking of us; if he expected to sell them at those prices to any one. The man said, "Tulare County demands that we defoliate and wash all trees that we send up there, and we have several orders from Tulare County, so we will take the leaves off these trees and wash them up and then they will look just as good as any tree in the nursery and no one will know the difference." There is the point —we can't get enough tree inspection. If we are going to admit trees from infested areas and allow nurserymen to use such methods as that, how are we going to prevent pests from coming in from all parts of the country?

The other point—I would like to suggest we bring up—I do not know exactly how to introduce it. I would like to ask Mr. Roeding, who is a representative in a way of the nurserymen of this county, this. A year ago this coming spring I went for a grower in my county into another county to inspect a nursery from which he had ordered trees. That nursery had been well cared for, and the owner of it had done his best to clean up the pests. I spent a day in that nursery, and found two or three trees only that were infested with one or two scales. I went back home again and told the gentleman who was about to place his order that in my judgment that he should not place it in that nursery. I would like to ask Mr. Roeding if he does not think I was justified in turning down that order upon finding in that nursery an infestation of red scale; I am simply using that as an illustration. Do the nurserymen feel that we should make an absolute tree to tree inspection at the point of shipment and turn down only those trees that we find infested, or will they admit that if we find any trees in the shipment infested we have the right, not only the right, but are we granted the privilege as it were by the nurserymen, to turn down the whole shipment, and if we find a nursery infested, even slightly, can't we quarantine with justice against that whole nursery?

Mr. Roeding. I do not feel that it is my duty to answer that question. It is one of the problems that it is very difficult on which to come to any exact determination. You refer particularly to red scale. You might use the same argument against other pests. You might use it against the flat-headed borer. Many nurseries in California carrying deciduous stock do not have the flat-head borers. Whenever those flat-headed borers are found in any stock the stock is thrown out. There is no reason in the world why an entire nursery should have their stock condemned because it happens that a few flat-head borers have been found on the trees. One thing further, I want to say, is that I think the only position the inspectors ought to take is that we are notified that we have these infested trees before these trees are condemned. The nurserymen should be notified of it, but I do not think because a certain pest is found in a nursery that the entire stock should be condemned.

Mr. Bloomer. What about the Japanese nurseries? The Japanese are growing millions of trees in this State, and a large number of responsible nurseries, and also the other kind, are buying trees from these Japanese. Now, how about these Japanese nurseries, Mr. Roeding? Do they belong to the Nurserymen's Association?

Mr. Roeding. I do not know of any that do.

Mr. Bloomer. Do you buy trees from those Japanese nurseries?

Mr. Roeding. Sometimes I make contracts to have trees grown.

Mr. Bloomer. Did you ever find trees infested with red or purple scale that they had grown?

Mr. Roeding. I do not know anything about that.

Mr. Bloomer. Is there anything in the by-laws of your association that would prevent you from buying stock from the Japanese nurseries?

Mr. Roeding. We haven't anything to that effect in our association that I know of.

Mr. Bloomer. You ought to have. You ought to organize among yourselves and agree not to buy infested stock. You have an agency in Sacramento that has your sign of the Fancher Creek Nurseries. That man in charge there buys trees from five or six other nurseries, and he has had trees condemned, and yet he is selling under the name of the Fancher Creek Nurseries, and buying stock from anybody, and you get the credit for some of it. You want to clean up among yourselves. The nurserymen want to get down to where they won't buy infested trees from these nurseries who are trying to sell unclean stock.

Mr. Roeding. My idea is that more will be accomplished by the nurserymen getting into closer contact with the county commissioners so that they will understand each other. I made the statement in my paper that there would always be more or less of a conflict on this one subject, and there is absolutely no question but that there always will be. California possesses wonderful climatic conditions, and its great soil conditions will develop, and has already developed, a greater variety of fruit than any other state in the Union, and that alone will cause it to have a greater variety of pests no doubt than any other state in the Union. California is far advanced even to-day in the combating of pests, not only in modern methods of spraying, but also by the introduction of predaceous and parasitic insects, and in my mind she will always continue along these lines, because California, more so even than the other Pacific coast northern states and territories, has taken hold of fruit growing and made of it a commercial business. Now the nurserymen of California have to supply the nursery stock that will be required for the development of this great commercial interest, and not only with the horticultural commissioners, who are the guardians of the fruit interest, and not only of the fruit interests, but all the other interests, and these interests are the nurserymen's just as well as the orchardists, and they should not pass new ordinances that are damaging to the nurserymen alone, but they should apply to the fruit growers as well. The nurserymen and horticultural commissioners, in order to correct the evils which are bound to arise, should try and work in harmony to bring about the best results, but those best results should not be brought about by trying to absolutely prevent the shipment of nursery stock because some disease may be found in some county or some district. All we want, gentlemen, is that you will try and harmonize with us, unite with us in trying to keep out the pests that we are just as anxious as you are to keep out, and not on all occasions try to make us the butt with your ordinances.

Mr. Dicks (Utah). I don't want to overlook this discussion at all, although my friend Roeding has defended himself very well and our interests as well, and I agree with all of you gentlemen, both fruit growers and your commissioners, that every care should be taken to protect your interests. Every nurseryman should be careful to give you clean shrubbery and healthy stock; we should spare no pains or expense in doing this. I came a long way from home just to be with you gentlemen, to see and meet you personally. I have learned of late years to take a great deal of interest in California, not because our business has extended to California, but because I have become acquainted with California's nurserymen and some of the fruit growers, and I expect to spend some time with you, attend your meetings and talk over our conditions with you, especially your commissioners and your chief commissioner, Mr. Cook.

Chairman Cook. I regret that we can not extend the discussion of this important topic. I will state, however, that we have appointed a committee on resolutions, and of course this matter will be presented to them, and these gentlemen having heard this discussion will deal with the question, and we shall expect something valuable from them.

We have one more paper this morning, and I now have the pleasure of introducing to you Professor Fawcett, who will discuss orchard sanitation.

ORCHARD SANITATION.

By H. S. Fawcett, Whittier, Cal.

The timeworn saying that "prevention is better than cure" holds true with as great force in the control of diseases of trees as it does in the control of diseases in the human species. It is also true that prevention is easier and cheaper than cure. Much extra labor and many thousands of dollars would be saved annually if greater care were exercised at all stages of the tree's life from the time it is in the seed and the bud till it is beyond the age of usefulness to the orchardist. There probably always will be used for effective remedies for attacks of fungi in trees just as in case of attacks of bacteria in man. Some tree diseases come to us at first unawares, and measures for their control are necessarily delayed until after the trees are suffering. It will not be the purpose of this paper, however, to treat of remedies and cures, but to emphasize strongly the necessity for using preventive measures when possible; to emphasize the value of getting in on the ground before the enemy arrives, or to put up barriers to develop such vigorous resistance that the fungi will have little chance to get in their work.

The Fungi.

The fungi are not mysterious kinds of organisms generated out of nothing, but they are real live plants growing from spores just as weeds or trees grow from seeds, each kind of fungus producing its special kind of spore, just as each kind of tree produces its special kind of seed. The spores rise to mold-like growths, many of them too small to be seen. even under the hand lens.

A Fight Between Tree and Fungus.

When a parasitic fungus attacks a tree there is, in a sense, a fight between two kinds of plants, the fungus-plant and the tree-plant. We have on one hand the resistance of the self-sustaining tree, which when healthy and vigorous is often very great, and on the other hand the attack of the dependent fungus. Conditions surrounding both the tree and the fungus have much to do with whether the tree can resist successfully or whether the parasite becomes established in sufficient amount or numbers to materially injure the tree. This explains why fungus diseases vary so in severity during different seasons, and why, at times, a disease may be attributed entirely to weather conditions, when it is due in reality to the attack of a fungus which has been encouraged in its growth by this particular kind of weather.

In order not to give a wrong impression in regard to these fungi it may be mentioned here that there are, living on the dead and even on the outer surface of living parts of trees above or below the ground, many kinds of fungi that the tree does not have to fight that are not parasites, that are never aggressive and possibly distinctly useful. As soon as any part of the tree dies or is killed, as by frost or dry winds or insect attack, these harmless fungi grow into the dead cells and live there. The presence therefore of fungi on the dead parts of a tree does not necessarily show that they were the cause of the death, though they may have been.

Recognizing this relation or fight between the tree and certain fungi, the fruit grower naturally takes the side of the tree against the fungi and employs specialists with their microscopes and culture dishes, etc., to tell him, if possible, what each kind is doing, how best the tree may be assisted in its fight, and when and where to strike the fungus as it threatens the tree.

Preventive Measures.

Some of the different means of prevention of fungus attack that may be used under varying conditions are:

1. Surrounding the tree with the most favorable conditions for vigorous growth and resistance; or,
2. Planting only those varieties or strains known to be resistant to attack; or,
3. Keeping the trees away from sources of infection; or,
4. Where these measures fail or are impracticable, covering its parts with a fungicide or its cuts or wounds with a suitable substance to keep the fungi out.

In the short time allowed for this paper only a few cases will be taken up, all of which come under the last two means of prevention, *e. g.*, that of keeping the plant away from sources of infection, and protecting it with surface applications of sprays or other substances.

Protecting Wounds and Cut Surfaces.

The protection of wounds or cut surfaces in fruit trees is of great importance. It is a common thing in some orchards to see projecting stubs more or less prominent left where limbs or branches of considerable size have been cut off. In many cases these stubs have died back and are seen to be rotting inward toward the heart wood. Whether toadstool or other fungous growths are visible or not, the rotting and decay is almost sure to be due to them. These fungi are usually only wood destroying forms and could easily have been prevented from entering. In cutting off limbs, it is of importance that they be cut flush with the remaining limbs and cut smooth. It is better to leave no projection at all, even though this requires a cut two or three times as large. The cut surface, if protected by suitable covering to keep out fungi, will heal over rapidly and leave a smooth surface. Butchering and hacking trees in the manner sometimes seen, is just an invitation to the weakest parasite to do its best in injuring the tree. In a small degree, at least, cutting off a hardened branch is like cutting off a finger. If a cut finger is allowed to be dirty and not disinfected, blood poisoning and pus formation will or will not set in, depending on the presence or absence of injurious bacteria, and in the same way slow rotting and decay will follow a cut or injury to a tree depending on whether injurious fungi or bacteria are present. If the wound is covered with a substance that is waterproof and at the same time a disinfectant, chance of decay is prevented. A covering for cuts and wounds that has been found most useful for this purpose in the experience of the writer is a liquid wax that may be put on cold with a paint brush. The formula is as follows:

Tree Wax.

1 pound resin.
2 ounces tallow.
6 ounces alcohol.
1 ounce spirits turpentine.

Heat the resin and tallow together, cool down somewhat and pour in alcohol slowly while stirring. Last stir in the turpentine. Use care not to get more turpentine than the formula calls for.

White paint and tar are often used with good success, but injury is sometimes experienced with some kinds of paints and with coal-tar.

Protection of cuts or injuries, the writer believes, should be begun in the nursery when fruit trees are first cut off, after the buds start to grow. It is probable that many nursery trees are handicapped from the start by allowing the bud to grow around a cut surface that has begun to decay.

Prevention of Root Rot Fungus.

Very different methods from that first described are to be used in the prevention of root rot or oak root fungus (*Armillaria mellea*). This fungus lives on roots or pieces of wood in the soil and its prevention lies is getting out all roots or pieces of wood when the land is being cleared of infected oaks, sycamores or other trees, and, if possible, raising annual crops on this soil, plowing it deep for a year or two before planting to fruit trees. In cases of orchards already infected only in certain areas or spots, the means suggested for preventing its spread is to quarantine or isolate these areas either by rooting out trees all along the edge of the infected area or by digging a trench about it and lining the sides with tarred paper. This tarred paper, the upper edge of which may be placed low enough to allow for cultivating and irrigating over its top, is to keep the roots of an infected tree from communicating the disease to a healthy one.

The rate of travel of the fungus on the roots of orange trees is from a half a tree to one tree per year in any one direction. For other fruit trees the rate of travel may sometimes be greater, depending on the kind of tree and possibly on the nature of the soil. Figs and pears and possibly some varieties of cherries and the native black walnut are the only fruit trees known to be practically resistant to its attack.

Prevention of Peach Blight and Leaf Curl.

A preventive method entirely different from either of the two previously mentioned cases must be used for peach blight (*Coryneum beyerinkii*) and peach leaf curl (*Exoascus deformans*). In this case prevention is obtained by covering the surface of the twigs with a fungicide before the spores germinate or before the fungus-filaments have time to penetrate the surface. If one could always tell just when the fall rains would begin or what the weather conditions would be, one could time his spraying perfectly, but this being impossible the time has been put by Prof. R. E. Smith and his coworkers at from the first of October till the middle of December for the first spraying, and about the middle of February, or just before the buds open, for the second spraying. Practice seems to have shown that the first spraying may be Bordeaux mixture about 5–5–50 and the second spraying lime-sulphur solution.

Methods of Prevention Vary.

The above description of the means of prevention illustrates only a few of the different methods to be used against fungous attack and points out the fact that while certain general rules may be applied for fighting certain classes of fungi, each tree disease, just as each human disease, must be studied and experimented with until a method best adapted to preventing that particular one is found. What will be highly successful in preventing one fungous disease may be an entire failure when applied to a different one.

In conclusion, the ideal line of prevention for fungous attack should begin at or before the seed is planted or the bud is chosen for propagation, with the thought of selecting varieties of strains naturally resistant to serious diseases. Then the cut surfaces or chance wounds should be protected and allowed to heal smoothly and without decay, the tree should be surrounded with the best conditions for growth, and therefore resistance to many fungi, and when all these fail and attack comes, as in case of special or new diseases, then to cover the parts with spraying solution to keep the spores from germinating upon the surface or to put up barriers when possible against them. The easier and less expensive prevention, rather than the more difficult and more costly cure, is what we should strive for in the control of fungous diseases.

Dr. Cook. The Committee on Resolutions is composed of the following gentlemen:

Mr. C. C. Chapman, Fullerton, chairman.
Mr. H. W. Kruckeberg, Los Angeles.
Mr. Geo. C. Roeding, Fresno.
Mr. A. G. Schulz, Porterville.
Mr. F. T. Swett, Martinez.
Mr. John Graf, Compton.

AFTERNOON SESSION.

CHAIRMAN COOK. The first paper to be given this afternoon is entitled "The Grape-leaf Hopper," by Prof. H. J. Quayle, of the University of California.

THE GRAPE-LEAF HOPPER.

By H. J. QUAYLE, Berkeley, Cal.

Introduction.

The commonest and most widely distributed insect attacking the grape in the United States is the grape-leaf hopper or "vine thrips," as many California vineyardists are inclined to call it. Taking the country over it is no doubt the most serious of all the grape insects. It is true that in this State the phylloxera has done more actual damage, but outside of California the phylloxera is not a pest in this country, although it is native to the states east of the Rocky Mountains; but the losses from phylloxera are largely passing away before the advent of resistant vine planting, while the insidious hopper is ever present, and, with the extension of planting in different sections, is increasing rather than diminishing.

Because of the more or less inconspicuous nature of hopper work, unless, of course, they are abundant, and the fact that they are present in some numbers every year, many growers are inclined to take hoppers as a matter of course; an inevitable factor in the business, like adverse weather conditions, something beyond our manipulation and something regularly charged to the general account of profit and loss. It is true that so long as the hoppers are present in small numbers, the injury they do is not important, and in such cases it is not worth while attempting anything in the way of control. But where their numbers are excessive, then the injury they do is considerable and a large toll is exacted from our vineyards.

Distribution.

Outside of California this insect is most important as a pest in the grape belts of Ohio, Pennsylvania and New York. Here in California it occurs in largest numbers in this great interior section, the San Joaquin and Sacramento valleys. It also occurs in the Coast valleys, but is seldom injurious there; and also in Southern California, but south of the Tehachapi it is most serious as a pest in the Imperial Valley.

Nature of Injury.

The first indication of injury by the grape-leaf hopper is represented by the pale spots scattered about over the leaf surface. As the feeding continues these pale areas become more abundant and finally the entire leaf is of a pale, silvery color. These leaves later turn brown, become dry and functionless, and at last drop from the vine. This dropping of the leaves, especially in the case of young vines, may begin as early as

April or May. In such cases of early defoliation the work is due to the overwintering hoppers. With the appearance of the young the number is greatly increased and thus the injury becomes still greater. By midsummer the second brood appears and the numbers are again greatly increased. If each of the females of the overwintering hoppers lays 100 eggs and half of this number hatch into females, which in turn lay 100 eggs, the progeny from a single individual at the end of the season will amount to 5,000. Thus, for each hopper that comes on to the vine in the spring there will be, if all conditions are favorable, 5,000 hoppers by midsummer. This accounts for the hoppers appearing literally in swarms by midsummer and later.

It is not until this time that most growers are at all concerned about the hopper injury, and it is then too late to do anything very effective. At this time a large portion of the interior of the vine has all the leaves dried and brown, and many more have fallen off entirely. This injury or complete destruction of the leaves prevents the berry from maturing properly, for it is in the leaves that the sugar and consequent sweetness and flavor is manufactured. Injury to the leaves also has its effect on the growth of the vine, the canes fail to ripen normally for the next year's wood, and many of the buds fail to develop in the following spring. In cases of severe hopper injury, therefore, not only is the immediate crop reduced both in quality and quantity, but the vine may be more or less permanently stunted or even killed.

Life History and Habits.

If in going through the vineyards at this season one picks up the leaves that may have gathered in bunches by the wind, or disturbs any of the green growth in the vineyard or along the bordering roadsides and fences, there will most likely be seen small, pale-colored insects that fly up before you and soon settle close by again. These are the hoppers as they are found in the winter season. During the warmer and brighter days they will be found actively feeding on a large variety of plants that may be growing within easy range of where they were feeding during the summer. With the cold, wet days, they do little or no feeding, and remain much less active, under leaves or rubbish, or protected by growing plants. At no time in the winter, however, do they feed so voraciously as during the breeding season in the full warmth of summer.

As the foliage appears on the vine in the spring, these overwintering hoppers leave their more varied winter food plants and attack the vine exclusively. By the time the shoots are four to eight inches long all the hoppers have deserted their winter plants and now remain on the vine until the leaves fall in the autumn. After feeding for three or four weeks on this new growth in the spring, the overwintering hoppers begin egg laying. The eggs are deposited on the under side of the leaf and within the tissues. They are inserted here by means of a saw-like ovipositor, and covered as they are on all sides, they are beyond the reach of any spray. The number laid is 75 to 100, they hatch in from fifteen to twenty days, and there appears the young hopper, which is a small, pale colored creature without wings, and is called a nymph. Feeding is immediately begun, the insect grows, molts or sheds its skin five times, and after each molt the wings appear larger until they are fully developed and the insect is mature, which requires a period of about eighteen days.

The season is now about the first of June (this varying with the locality and year) when the first of these that have hatched from eggs in the spring have wings and fly about more or less actively. This is the time, as I shall point out later, when spraying can be done to best advantage for the young or nymphs. At this time also the old hoppers that have remained over winter begin to die off and are all gone by midsummer. This second or spring generation deposits eggs in July and August and die off in September and October. The eggs that these have deposited give rise to young which are maturing in August, September and October, and these stay with the vine until the leaves fall, when they take to the more varied diet during the winter and come on to the vine again in the following spring. There are thus two generations in a season, the young of the first beginning to appear about the first of May and the young of the second generation from about the first of July, or sooner in the earlier sections.

Control Measures.

From the practical grower's point of view the most important thing concerning a pest is how to control it, or how to keep it under subjection to the extent of not seriously damaging the crop. It should be understood at the outset that the grape-leaf hopper is a very difficult insect to handle successfully, and in my opinion the last word along this line still remains to be said. The most important factor that militates against successful control with this insect is its activity in the adult stage. The full grown hoppers readily escape before any spray. Spraying is likewise of no avail against the eggs, for these are securely tucked away beneath the surface tissue of the leaves. Spraying will, however, kill the young. Another drawback to the control of this insect, or any grape insect for that matter, is that the expense is likely to extend too far into the margin of profit from the crop.

General Cultural Practices.

Some growers believe in plowing the vineyard in the winter or early spring with a view to reducing the hoppers. Plowing will not kill the hoppers directly, for they are active enough to escape readily before the plow. During cold or wet weather, when the hoppers are more dormant, a few may be turned under, but, generally, plowing is not done under such weather conditions. Plowing may indirectly affect them, however, by depriving them of food in turning under the green growth in the vineyard or of destroying their hibernating places as represented by the accumulation of leaves or other rubbish. Turning sheep in the vineyard in the fall to eat the leaves, as is sometimes practiced, has the same result.

Plowing and sheeping, therefore, result in driving the hoppers elsewhere for food or shelter during the winter season without actually killing them, at least in any significant numbers. There is nothing to assure the grower, moreover, that his vineyard may not be infested again in the spring from the bordering roadsides and fences, or from neighboring vineyards. For such measures to be appreciably effective it would require a general community effort without considering whether this would be the best general practice for the vines. It appears to be a wise procedure to get as much material turned under in the spring as possible.

Spraying for the Young or Nymphs.

The young hoppers may be very readily killed by means of a spray applied to the under side of the leaves. The nymphs are readily killed by a spray because they do not fly and hence cannot escape before the spray. The spray also strikes their bodies and the breathing pores directly, whereas with the adults the wings are held roof-like and very completely protect their bodies from the spray material.

The time to spray for the nymphs is just before the first of them become winged, and this will be during May and the first part of June, depending upon the season and locality. The kind of spray is not important, for several different materials will kill the nymphs. Foliage injury must, of course, be avoided. The material probably best answering these requirements are whale oil soap and tobacco. Whale oil soap may be used at the rate of 15 pounds to 200 gallons of water. The most desirable form of tobacco is the commercial black leaf, for it contains a uniform nicotine content. Black leaf 40 may be used as follows:

1 pint black leaf;
4 pounds whale oil soap;
200 gallons water.

In the grape sections of the east the final recommendation of the Bureau of Entomology at Washington for the control of this insect is to spray for the nymphs with tobacco. In work carried on with this insect in this State five years ago, spraying was recommended as a successful means of controlling the nymphs; but it was also stated that many adults are present at the same time which would not be killed by the spray, and that there were also eggs in the leaves that would not be killed. The presence of eggs and adults, which are not affected, is the most serious objection to spraying, although there are enough nymphs killed to materially reduce the numbers of the succeeding generation.

The canes of the California vines are also pretty long by the first of June, so that the problem of hitting every nymph on the under side of every leaf is not an easy one. Moreover the breeding period seems to be more prolonged here than in the east, where the seasons are definite, and hence there are more eggs and full grown hoppers that are not killed.

Mechanical Control.

It was with a view to capturing the hoppers in the early spring before any eggs would be deposited or before any injury was done, that a screen box was devised. This consisted of a square framework covered with wire netting, open on one side and with a galvanized iron tray forming the bottom, with a V-shaped opening, which allowed it to be pushed onto the vine, at the same time the hoppers being jarred off and caught in the crude oil that was smeared on the screen. This was intended for vines headed some little distance from the ground, for most of the hoppers fell on the tray or low down on the sides. This sort of an apparatus is not satisfactory for vines that are so low headed as many of them are in this vicinity, nor is it applicable for trellised vines. With the right shaped vines such a cage can be used very successfully and 90 per cent of the hoppers captured at a time when for each one taken it means, as I have shown, possibly 5,000 less later in the season.

It was thought that a cheap apparatus as I have described, that anybody could make, would appeal to practical growers, but that is not the case. California growers have an inherent desire to do things on a large scale, and anything that can be pulled with four or five, or a couple of dozen horses, or a caterpillar engine, comes nearer to satisfying their idea of how things should be done. For this reason I have some hopes that such a machine as Mr. Driver of Dinuba has devised may be made to work successfully. The idea of drawing the hoppers away from the vine by suction is an old one and has not yet been thoroughly tested out. I do not believe, however, that midsummer or later is the time to operate such a machine. Great numbers of hoppers are, of course, captured at this time, and it is spectacular enough, but they should be captured before they become so abundant, and before the vines show such conspicuous injury as they do at this season. By this time practically all the injury has been done and all the young have developed, and there is no assurance that they may not be abundant there the following year.

If such a machine would take the over-wintering hoppers at a time when the shoots are six to eight inches long, before any damage was done and before breeding commenced, it would be the solution of the hopper question. I hope those interested in such a machine will try it early next spring. Some preliminary experiments in spraying into a canvas canopy pulled over the vines also gave some promise of control at this season.

Conclusion.

Those of you who came to hear definite and specific recommendations for the successful control of the grape-leaf hopper I fear will be disappointed. I do not believe in giving such recommendations until we have them and they are thoroughly tested out in practical work. Your experiment station started an investigation of this insect five or six years ago to continue at least two years. During the first year it was intended to study the insect itself, since this is essential for any control work, and the second year to test various methods of control. A portion of a year's study was made and all the important facts about the insect itself were found out, but after the first year the funds for investigation lapsed and no adequate opportunity has since appeared for continuing the work.

As our knowledge goes at present, spraying for the nymphs in May or the first part of June would pay well if the hoppers are present in excessive numbers, or capturing by some mechanical means, preferably in the early spring, when the shoots of the vine are six to eight inches long.

CHAIRMAN COOK. Ladies and gentlemen, this subject is open for discussion.

A MEMBER. I have been keeping my vineyard clean and since I have I have not been bothered so much. I realize that the pests migrate considerably, but if we keep a section thoroughly clean there is less liability of the pest, and we can keep the trouble out for a season, but will they work so much damage if they are forced to go from place to place?

PROF. QUAYLE. In large sections that are kept clean there is perhaps less liability of the vineyards being freely infested. The hoppers generally don't get in their deadly work until spring or until late in the summer. They may by that time spread generally over the section, but if you can keep the vines more or less free until that time the injury will not be very great.

A MEMBER. You are overlooking one point which is essential. Do some of the hoppers that are alive in September remain alive all winter?

PROF. QUAYLE. Yes. I have noticed that the sections abounding most with these pests are along the roadsides or on ditch banks, and along fences and spots that are left uncared for, and around such places they are most numerous and occur in great numbers. We should pay more attention to keeping our farms clean during the months of November and December, and to a great extent this will eliminate this pest.

MR. HAMPTON. I have had some experience with this hopper. I have a small vineyard, not more than five acres, and I have observed that although this vineyard is kept clean during the summer that the next spring the hopper will appear all around the edges, and that its appearance around the edges where it has come in from the surrounding fields and places where the insect has been harbored will show throughout the whole season the great effect of the hopper, while the interior of the same plot, not more than five acres, will not be affected nearly as much. This would show that a large tract of land may be largely protected as my vineyard was by careful cultivation and keeping all of the rubbish that may be there out of the vineyard, and perhaps by catching the insects early in the spring at their first appearance and destroying them. But the small vineyardist will find that more difficult. Now I have been very much impressed with what Professor Quayle has said in regard to the first crop being the one which should be controlled if possible. I agree thoroughly that with the first appearance of the insects if they could be dealt with and destroyed, using such methods as have been described here, that the great damage which has been done heretofore to the vineyards would be obviated. You could then go on and collect and harvest a good crop without fear of the second crop of insects doing so much damage, because if on its first appearance the insect is destroyed, of course there will be a much smaller second crop appearing. Now, then, I have a little orchard of eight acres which for three years has not been producing more than a quarter to two thirds what it should on account of the hoppers. The vines were so badly infested, and affected to such an extent, that by harvest time they were absolutely denuded of leaves, and the sun so scorched the fruit that we could not harvest more than two thirds of the crop. Last year for some reason that same vineyard produced two tons of fruits. There were plenty of hoppers last year too, but they didn't get started so soon. The first crop was less and consequently the second was not large enough to destroy the crop for that year. I have examined the machine referred to by Professor Quayle. This machine is hauled by four horses and costs seventeen hundred dollars. If there could be a small engine to draw the machine or even possibly it could be something on the order of a mowing machine; the power produced by the horses could produce sufficient suction with a small apparatus that could be made of canvas to cover the vines and draw in this first crop of hoppers as they appear. They will appear on the vines just as soon as the warm weather comes, and they start work just as soon as the vines leaf out. Now, if something could be contrived, without much expense as I believe it could, to collect that first crop of insects, you would do away with the necessity of having to do anything with the second crop.

Mr. Perkins (Fresno). I find that the hoppers are very much worse on other vines than on the Muscats or Thompson Seedless. Two years ago we had fewer hoppers than we had last year, or in previous years for two or three seasons. Now, I would like to ask if it could possibly have been due to the frost that we had, that it caught the hoppers at just the right time to weaken their numbers? It is the only possible explanation which I can give of their being so much less that year than they were this season.

Prof. Quayle. I agree with the gentleman that a year ago last spring the frost was probably responsible for the diminishing numbers of the hoppers to a great extent. They come out in the vineyards in very large numbers in many places of this section and I was planning to do some control work, but the frost practically killed all the leaves on most of the vines in some vineyards, thus the hoppers suffered for want of food. The vineyards had already been plowed, and so there was absolutely nothing for them to feed on and very large numbers were destroyed. The frost undoubtedly caused the disappearance of the hoppers a year ago last spring.

Dr. Cook. This is an important matter for us and I feel that it is a matter that should be discussed thoroughly by the convention here. It seems to me that it is a subject that should be taken up earnestly by the entire community. Early cleaning up of our vineyards and fields will decrease the damage caused by these hoppers and why should we not make it a community proposition, and clear up our vineyards early? To a great extent it would lessen our heavy losses.

A MEMBER. I would like to ask if alfalfa fields surrounding vineyards will breed the hoppers as much as rubbish, etc., will.

PROF. QUAYLE. Alfalfa is not a favorite food plant of the hopper; but if the alfalfa is adjoining the vineyard, no doubt they will also sustain themselves very admirably during the winter season.

CHAIRMAN COOK. As Dr. Hunt is now present, I will ask him to preside over the remainder of the afternoon meeting.

DR. HUNT. You all know Mr. Richmond, I am sure. Mr. Richmond has much experience in the handling of prunes, and I have great pleasure now in introducing to you Mr. E. N. Richmond, who will speak to you on the prune.

PRUNE CULTURE.

By E. N. RICHMOND, San Jose, Cal.

I have been asked by the State Horticultural Commissioner to prepare a paper on the subject of Prune Culture, consisting of short concise facts relative to this industry from the time of the planting of the trees until the fruit has been prepared for market, to be read before this convention. I shall adhere to facts as I have found them through experience.

The successful orchardist of today, no matter what variety of fruit he is producing, is the man who uses common business judgment in addition to a general knowledge of soil, tree growth and care. This statement applies to all horticultural interests. Fruit growing, to a degree, is a business, and must have the same consideration as any other business.

It will perhaps be of interest to you to know the tale of how the prune was first introduced into California from France, the country to which today we are shipping a goodly portion of our production, even though France and many other sections of Europe are still producing prunes. In 1849 Louis Pellier, a French sailor, arrived in San Francisco and went to work in the mines of Trinity County. He did not succeed there, and finally moved to San Jose in the early fifties. There he started a nursery on the property which today is owned and occupied by his nephew. He soon after induced his brother Pierre, whom he left in France, to join him in California. The two brothers worked the nursery together until the spring of 1856, when Pierre returned to France on a visit. Upon his return to California he brought with him a large number of prune and other fruit cuttings. The prune cuttings were procured in the Ville Neuve d'Agen, from whence the common California prune derives its name, Petit Prune d'Agen. With these cuttings the first prune nursery on the Pacific coast was started.

For many years little thought was given to the commercial production of the prune, but attention was turned to the raising of prunes on a commercial basis about 1880, and from that time on it has been ever on the increase until today the State of California produces, with normal crops of the world, between 50 and 60 per cent of the entire world's output.

To one contemplating the planting of a prune orchard, the first consideration must be given to locality. Inasmuch as the State has been thoroughly exploited on prune producing, the matter of judgment and fact must prevail in your selection of the district of the State in which you are going to plant.

The second consideration is soil. There are thousands of acres planted to prunes in this State to-day that are not adapted to this variety of fruit, and should have been planted to some other variety of fruit or to vines. The prune tree requires a deep, rich sandy or loamy soil, and from that to a heavy soil, well drained. Upon such soils water is generally obtainable for irrigation purposes. Light or shallow soils do not grow successful prune orchards. Such a soil as first mentioned will grow large thrifty trees capable of producing annually from 5 to 10 tons of green prunes to the acre of large sized fruit, as compared to trees planted upon soil not adapted to prune growing, which soil will grow only a small tree capable of producing from 2 to 5 tons of prunes to the acre of small fruit. Competition is bound to enter the producing field as well as other fields of the business world, and it is the man who can produce at the lowest cost who will be the most successful in this business. The lowest cost means the greatest tonnage of good fruit to the acre and not economy in the working of the property; hence, the necessity of giving the question of soil a very thorough consideration and investigation.

The third consideration is the root upon which your tree is budded. In my estimation the myrobalan is by far the most successful root to plant for prunes, for the following reasons: first, it is the hardiest, and is long lived; second, its roots naturally seek moisture, giving you a deep rooted tree; third, it will stand more moisture and is not subject to soursap to any where near the same degree as the peach or almond root; fourth, the fruit produced from the tree on myrobalan root is firmer and will show a less shrinkage in drying than either of the other roots, thereby making a heavier fruit or grade than the fruit produced on trees budded to other roots.

If your soil is of a light character, then either peach or almond are better adapted, but for genuine prune soil, the myrobalan is the root to select. Of the other two roots generally used for prune, the almond is preferable to the peach. Trees budded to the almond root are good producers and much longer lived than trees budded to the peach root.

The question of planting on the square or triangular system is largely a matter of choice. On the triangular system a few more trees can be planted to the acre. Do not plant your trees too close together. Plant anywhere from 22 to 27 or 28 feet apart. The farther apart you plant, the better opportunity are you going to give the trees to develop into large thrifty trees—they have more air, sun, and room to develop.

Prior to planting, plow your soil and plow deep. Plowing in the orchard business does not mean skimming over the surface of the ground. It means getting down from 8 to 11 inches. This can be done with a disc plow and good stock. Use a sub-soil plow and put in down deep along the rows in which you are going to plant your trees, so as to break the under crust and give the young root of the tree an opportunity of easy growth.

During the past few years, dynamite has been used in the starting of a young orchard, with excellent results, by blowing up the hole in which you are going to place a young tree. You loosen all of the soil and give the root every advantage of growth.

Planting for the most satisfactory results should be done either during the latter part of December or through January or February.

The selection of nursery stock is a very important factor toward success. Select one year old trees, good clean roots and plenty of them, with a straight top from four to six feet high. As soon as you get your stock from the nursery, heel in the ground in good shape until such time as you are ready to plant, for it must be remembered that the small rootlets are very sensitive to cold or lack of moisture.

Before planting, examine the roots closely, cutting off the bruised or broken ends of the roots that have been damaged while being handled at the nursery. Examine closely for blackknot or for indications of the peach borer.

Have your ground carefully laid off so that each tree may be placed in its proper position. When you are ready for planting, use the planting board (which is made by taking a one-inch by four-inch piece of wood four feet long, cutting a notch in each end and one in the center), placing it so that the stake which indicates where the tree is to be set will be in the notch in the center of the board and then place a stake at each notch at the ends. Remove the board and center stake and you are ready to dig the hole.

When planting, dig a hole deep enough so that when the end of the long root going downward rests on the bottom of the hole, the tree will rest two or three inches deeper than it did in the nursery. This means that the point at which the tree is budded is just about on the surface. Very great care should be taken so that the soil is well worked between the roots, using as fine a dirt as possible, and that every root goes out naturally from the tree. If this is not done and the soil is thrown into the hole carelessly, the roots will all be crowded together to the detriment of the future growth of the tree. Head the tree back to within from 1½ to 2 feet from the ground. As good a system in securing the measurement for the heading of a young tree is to cut at a point which measures a trifle above your knee cap.

The most careful consideration should be given to the question of pruning, and here again judgment must be used. Remember you are going to produce fruit for a profit and not wood. At the end of the first year you can commence to mould your tree into shape. About four main limbs from the trunk should be allowed to grow and develop. These limbs should be trained through pruning so that the center of your tree is left open for sunshine, air and the development of fruit producing twigs. Judgment must be used as to the number of branches and laterals which are allowed to grow from the main limb. By proper pruning it is possible to bring a young prune orchard into producing from 1,000 to 2,000 pounds of fruit per acre at the end of the fifth year; at the end of the sixth year from 2,000 to 5,000 pounds of fruit to the acre. From that time on there is a gradual and steady increase in production as the tree ages. The inside twig wood will be the first to produce. Many growers make the mistake of pruning their orchards only once in every three or four years. A prune orchard should be pruned, not less than every other year, and the grower who trims his orchard each year secures the most satisfactory results. Strive to keep new wood growing and renewing the tree.

Through the spring and early summer months cultivate the ground frequently. Plow first and follow with a harrow, spring-tooth harrow (which is an excellent implement for leveling the ground), disc harrow or cultivator. Finish your cultivating by leaving the ground well pulverized and smooth for the pickers. In the Santa Clara valley deep fall plowing has been resorted to by many with great success. It has been found that deep fall plowing—from 9 to 11 inches—following irrigation is the best remedy against thrip—a pest preying upon the tender young fruit buds in the spring months. Following the fall plowing the spring plowing can be dispensed with if one desires to do so. The spring work can then be carried on with a disc harrow, cultivator and other implements to good advantage.

It has been found in all fruit growing that "Water is King." Fall irrigation immediately following the harvesting of the prune crop acts as an insurance for a crop for the following year, it being a tonic to the tree. Through water, the tree is given additional nourishment after having gone through the dry summer months producing fruit and growing wood; and the young fruit spur is strengthened and becomes strong and vigorous before the tree goes into the dormant stage. Water should be used during the late spring months, thereby insuring the tree with ample moisture and nourishment to carry it through the summer months and through the producing period.

Fertilization should be given serious consideration. The question of fertilization is another story, but you must appreciate the fact that the trees cannot continually take from the soil and continually produce unless you, on your part, are willing to renew the soil by fertilization.

The keeping of the bark of the tree in a clean and healthy condition must have your attention. This can be done through the system of spraying. The most popular sprays for this purpose being crude oil emulsion, distillate emulsion, known as Buggo, and the lime-sulphur spray. The best time to spray for this purpose is through the months of December, January, or February. The spray outfit, oftentimes in some sections of the State is again called into use in the fighting of the thrips. It has been successfully proven that this insect can be kept under control by the use of any one of the two or three different well known spray solutions.

The prune tree will blossom the latter part of March. Fruit sets immediately following the falling of the petals. A person can generally gain a fair idea as to the kind of a crop he is going to have by the latter part of April. Fruit ripens during the latter part of August and it is of a rich purple hue when ripe.

Prunes should never be picked from the tree. They should be allowed to thoroughly ripen and fall to the ground of their own accord. An orchard should be covered by pickers picking the fruit from every seven to ten days—every seven days preferably, so as to prevent sunburn. The usual form of contract with pickers calls for four pickings, no shaking of the trees until the third picking, and then at grower's discretion.

The green fruit is hauled to the dipper shed in picking boxes and there passed through a light solution of lye. A kettle or tank, holding two hundred gallons of water and containing a basket container is used for this purpose. In many instances the fruit is rinsed by passing from this dip into a vat of clear water and then dumped on to a combination pricking board and grader, which grades the fruit into three grades, so that the drying in the field can be uniform, the grader being operated by power. The fruit is then placed on eight foot trays and taken to the drying yard and dried in the sun. The purpose of passing the fruit through the lye solution and over the pricking board is that the skin of the fruit may be slightly cut, thereby preventing fermentation and producing a fruit with a clear, bright meat. Many of the small growers do not use the combination pricker and grader; they dump the fruit directly from the dipper basket to the trays, allowing all sizes to be dried together. This is not as satisfactory to the grower as the first mentioned method. The most satisfactory and economical method of handling from the dipper shed to the dry yard is to use a one-horse truck especially constructed for this purpose.

The question of drying is again a matter of judgment. Fruit should be allowed to lay in the sun on the trays until about three quarters dried and then stacked in piles one above the other, leaving air vents on either end. About twenty trays can be stacked in one pile and the finishing process takes place in the stack. Under normal weather conditions it takes from ten days to two weeks to cure prunes. It has been found most satisfactory while the fruit is on the trays in the dry yard, to give the fruit, at least, one turning by hand, shaking the trays or with brooms, so that the fruit secures an equal drying on all sides. It also materially lessens the time of drying and makes a finer grade of fruit. Do not take your fruit 'from the trays until it is thoroughly cured. This word of caution means the salvation of your business.

A packer cannot turn out, to the trade, a first class article unless that article is delivered to him by the producer. During the past years most of the complaint against the keeping qualities of the prune has been due to the desire on the part of the grower to retain too much of the original weight in the prune, with the result that he has delivered prunes to the packing houses which were not properly cured. In many instances, these prunes have not been detected at the packing-house door and have found their way to the trade, with the result that fermentation has set in and the buyer of the California prune loses confidence in the commodity and refuses to handle a commodity against which he has incurred heavy losses.

Good prunes, well cured, will build up and encourage an ever increasing demand. Prunes poorly cured will tear down and discourage this demand, so that before taking your prunes from the trays be positive in your own mind that they are properly cured. After properly curing, the fruit is taken from the dry yard to the dried fruit house of the orchard and there dumped into bins. From there it is sacked and delivered to the packing-house.

Every fruit producer should know by actual and careful testing what each load of fruit tests to the pound when .he delivers to a packing-house, no matter to whom he is delivering. This is not only justice to himself, but it is justice to the man with whom he is dealing. If he knows positively what his fruit tests, he will ordinarily have no complaint to make at the test he secures from his packer, but if he does not make such a test, he is apt to be dissatisfied.

At the packing-house the fruit is carefully graded into the different grades, varying from 30 to 40 prunes to the pound up to prunes running smaller than 120 to the pound. The grades as to weight and size are obtained by passing the fruit over a large grader which consists of a series of screens of different sizes, commencing with the smaller size and increasing to just a trifle larger size every three or four feet. There are from eight to nine different screens, the larger fruit passing over the end of the grader. As the fruit comes from the grader it is carefully tested and taken to the proper bin. From there it is taken as required for packing purposes to the processor or cleanser. The fruit in the field has been subjected to considerable dust and dirt, as well as insect life. The processor or cleanser conveys the fruit through a long vat of boiling hot water, thoroughly washing and cleansing the fruit. From the processor, the fruit is dumped on a long shaker which further assists in the cleansing process, so that by the time the fruit is put into the boxes, it is in a most sanitary condition.

Prunes are packed in packages varying from one pound to fifty-five pounds. A large amount of help is given employment in the handling of the fruit. The packing allowance made by the trade for fruit packed in various sized boxes all goes back to the various industries of this State, such as the box factories, paper companies and to labor. Packing has been a source of a tremendous income to the State of California. A number of years ago a large portion of our dried prunes were shipped in bags to the larger wholesalers of the Eastern States. They did their own packing, under the most crude methods, with the result that many spoiled and unattractive prunes were put upon the market, as well as prunes from various districts being mixed with our Santa Clara prunes or packed and branded as Santa Clara Valley prunes. In California to-day every packer is equipped with the most modern machinery and the investment in a packing house amounts to considerable. Men are in charge of the various departments of the packing-houses who have had long experience in the handling of fruit, with the result that our fruit is being turned out to the trade well packed, in good keeping condition and in attractive packages.

The improvement in the producing, curing, and packing of the California prune, as well as its original quality, has made it the most popular prune in the world to-day. Even though there are large prune producing sections in Europe, nevertheless our California prune has such a recognition throughout the European countries that to-day we are exporting from 50 to 60 per cent of our entire output annually, and we are importing from Europe nothing.

The prune industry in this State to-day represents an annual average production of 175,000,000 pounds of dried fruit, or an annual income to the State of from seven and one half to ten million dollars. It deserves the most careful attention; first, on the part of the producer, in seeing that he is producing an article of high grade; second, on the part of the packer, in giving the closest attention to the packing of the fruit delivered to him, that the fruit might be delivered to the trade in the most sanitary and attractive manner possible; third, on the part of our State Horticultural Commissioner's office, in seeing that the industry is given his most careful attention and protection.

In conclusion, I will say that prune producing is one of the most profitable of fruit productions when proper care has been given to the selection of the soil, to the class of trees planted, to the care of these trees and to the curing of your green fruit.

CHAIRMAN HUNT. This very carefully prepared paper, very valuable paper, is now open for discussion. I hope we will have some questions.

MR. GALLAWAY. I would like to ask a question. In regard to the root for the prune tree, you mentioned the almond, peach and myrobalan roots. What do you think of the apricot root for the prune tree?

Mr. Richmond. From general experience the apricot root has not been successful for budding purposes. The trees are not long-lived.

Mr. Messenger. Regarding dynamiting the holes, in Glenn County recently I learned that some holes had been dynamited in soils that were not dry, and they were not successful. Have you had any experience along this line?

Mr. Richmond. I hardly know, but think that perhaps in case the dynamite was used in damp, wet soils, the fumes were not there, and that might have been the reason. They might have affected the roots of the trees. In dynamiting in damp soil there is not the same air for evaporation. Dry soil will dynamite much more rapidly and give much better results than will wet soils.

Mr. Hutchinson. One question: You say you commence gathering your fruit in the Santa Clara Valley in August, the first of August?

Mr. Richmond. Yes, about the middle of August.

Mr. Hutchinson. And you never pick your prunes, you shake your trees, you say.

Mr. Richmond. Until the last picking, they should always be shaken.

Mr. Hutchinson. I understand then that the tree must not be shaken at all. We are obliged in my locality to knock off or shake our trees sometimes by the tenth of the month, because it is getting so late that we cannot dry them.

Mr. Richmond. What proportion comes off the trees by the time you have to shake them?

Mr. Hutchinson. Not more than one half. It seems to me that this State is capable of raising everything there is, but there are certain places that are more adapted for vines, raisins, and peaches than are other localities.

Mr. Galloway. I wish to speak of the Imperial prune. In Sonoma County the most profitable orchards we have are Imperial prune orchards, but they are very limited in extent, and it is a custom to plant the Imperial prunes on heavy soils. They should be planted on the higher bench lands. This is not high for your lands, but lands that are well drained and not too level and where they will produce a sufficient amount of sugar. The great trouble is where they are planted on level grounds, and trees dry out and do not produce a sufficient amount of saccharin matter to enable them to be well cured, and the great trouble with such prunes is that they will ferment and make trouble after they are processed, so the Imperial prune is the most profitable crop we produce in Sonoma County, where it is planted on the right kind of land.

Mr. Richmond. In Sonoma County you really haven't two or three hundred acres planted of the Imperials that you consider fit, have you?

Mr. Galloway. About five hundred, I believe.

Dr. Cook. I want to express my satisfaction and gratitude to Mr. Richmond for this paper. One of the most common letters we get at our office is for bulletins on the prune question. So many requests come in, and we have not been able to supply them; we have had nothing on prune culture, but now we are going to get out separates on this article, and as my friend, Mr. Hickman, said, these bulletins form the most valuable crop we have. You know the one on dates, well, we shall have another now on grapes, and one now that is nearly ready on citrus fruits. I hope to get monographs on all these subjects. Anything you want to know on these subjects that we have you can get by writing in to our office. I want to thank you, Mr. Richmond, on behalf of the audience for this admirable paper.

CHAIRMAN HUNT. The next paper is on details in citrus culture. I understand that Mr. Chapman is considered the best authority on citrus culture in this country, and I now take great pleasure in introducing Mr. Chapman.

DETAILS IN CITRUS CULTURE.

By CHARLES C. CHAPMAN, Fullerton, Cal.

The culture of the orange is one of the most fascinating, and at the same time most discouraging branches of agriculture. This fruit perhaps requires closer and more constant attention than any other fruit grown for profit in this country. This is accounted for in part by the great length of time required to mature oranges, the numerous persistent enemies which prey upon them, their delicate and susceptible nature, the large amount of money value represented, and the natural interest arising from watching the ever changing phenomena incident to their development to a high state of beauty, succulency, and usefulness.

While orange culture is fascinating, few men are undergoing all the disappointments and annoyances incident to the business these days for the mere pleasure they may derive from it. It is profit rather than pleasure which is the incentive to practically all growers. It is essential, therefore, that in every possible respect conditions be followed which will produce the greatest profit.

In the production of citrus fruits, as with many other varieties of fruit, California excels the world. In proof of this sweeping statement, a little commercial evidence from our most exacting market will be given. I quote from the *Fruitman's Guide,* published in New York City:

> "There is no disputing the fact that when it comes to extracting top-notch prices out of the buyer's pockets the California orange has the call, first, last and all the time. Florida may talk of its justly celebrated Indian River fruit; the West Indies may put forth the claims of her yellow-skinned globes of sweetness, but the Golden State, with an orange that combines beauty with savor, in the

> highest degree, and appeals to the eye as powerfully as to the palate, unquestionably wears the crown."

It may be interesting to hear the high estimate in which the Florida orange was held by travelers visiting that state years ago. The statements quoted may seem extravagant. I have speculated a little as to the language the writer would have employed to have expressed his thrill of delight could he have gotten one of our splendid Washington Navels, or our incomparable Valencias. Here is what he said, which is taken from *Blackwood's Magazine,* 1885:

> "The Florida orange is a delicacy by itself, hitherto unknown to the world, and which Spain need never attempt to rival. Between an Indian River orange and the coarse-grained, spongy, bitter-sweet product of the Mediterranean there is nothing whatever in common. The one is a thing to be eaten in the usual routine of life, the other is a delicacy which we can only hope to stumble on at rare moments. A ripe Floridian, well grown and in good condition, melts in the mouth like a juicy peach. It is nectar in poetic form, and the fashionable mode of eating it in Jacksonville is to cut it in two and empty it with a teaspoon. So delicate is the pulp, and so tender is the skin that the one difficulty in enjoying it is in handling it."

Another picture given in *Chamber's Journal,* 1885: "The orange groves of Florida are already the largest in the world, and the quality of their product is unequalled by the choicest fruits of Europe, Syria and Brazil." The writer informs us, however, that the cockroaches, mosquitoes and all insect life in Florida are "a huge and permanent affliction," and that "as horticulture is the only business that can be carried on in Florida and as insects are vastly destructive, to fruits and vegetables, it is the height of folly to annihilate the small birds. The orange tree is the prey of many insect parasites, and sometimes a whole grove is blighted by them. I have seen scores of trees ghastly with scale, and owners almost driven to desperation."

A warning to growers as well as some information as to the life of the orange tree may be noted in the following quotation from the *Tropical Agriculturist,* an English paper, of 1882:

> "In the Azores, up to 1836, the oranges were in perfect condition—no care, no attention, no labor was given them, save the picking and packing. They were left without manure, without draining and maybe without pruning. Suddenly, however, a disease appeared—trees two hundred and three hundred years old, and producing each six thousand and twenty thousand oranges were disappearing. It was observed that all the trees affected produced a very heavy crop the very year that the disease manifested itself, that the leaves became yellow and fell off in great quantities, and on the trunks, or stems near and sometimes beneath the ground, the bark opened and drops or tears of yellow gum

> exuded, and hence the disease was called 'Lagrima' from the Portuguese word for tears."

The inference made by the writer is that the people richly deserved what they got—the destruction of a fine industry, the far famed St. Michael orange. The people danced and amused themselves while the orange trees bore fruit, but years of reckless neglect brought disaster.

While it is a pleasure to be with you, I am frank to say that I am unable to bring you anything new or revolutionary, or to divulge any secrets in the culture of citrus fruits. I am sure many of you are quite as well informed in all phases of the industry as I am myself. If we can, however, in this general conference, mutually inspire one another with a determination to produce a higher grade of fruit and take better care of it, I am sure the citrus growers who are present will consider ourselves amply repaid for this conference.

There is a demand, and there will always be, for high grade fruit. That demand cannot be readily supplied, and our aim should be to meet the requirement of the most exacting market, and not to be satisfied with simply growing oranges that must be forced into consumption by low prices.

The quality of the fruit we produce will largely gauge the financial returns enjoyed. The orange, like the chrysanthemum, is susceptible of high development, and I believe there is less excuse for one of us to grow an inferior orange than for the professional florist to grow small, sickly flowers for his market. The fact is, we cannot afford to produce anything but the best, for anything less affords neither satisfactory revenue nor that degree of mental enjoyment which ought to be at least a part of the returns we should expect from the business.

The first efforts of an orange grower must be directed to the selection of location, the preparation of the land, the quality and condition of the stock, manner of setting it, and provision for a reasonable amount of irrigating water. Some varieties are better adapted to certain localities than others. The difference is often that between success and failure. Remember in the competition which the largely increased production we are soon to have will severely test us. The survival of the fittest will be the ultimate result. Therefore, select a variety adapted to your particular locality, not permitting yourself to be influenced by a desire to grow an orange popular in other localities, but not the best for yours.

It is important that a location be selected free as possible from extremes of temperature. While we may, to an extent, successfully overcome low temperaturs, it is both expensive and dangerous to tempt Jack Frost. He may swoop down upon us without warning and when we are unprepared. I fear that during the present period of much setting of citrus orchards, many have been located where nature never intended trees comparatively easily affected by cold should be planted. It is also evident that soil conditions unfavorable to the production of the orange have been overlooked in this widespread desire to set out orchards. The result of this want of good judgment and the violation of the laws of nature is likely to be, not only an individual loss to those who heedlessly ignored them, but an injury to the reputation of the orange business and a consequent loss to all.

The land selected, whether level, gently undulating or quite hilly, must be put in condition for setting before the stock is taken from the nursery. A little work done then will often save a great deal of time and labor in the future care of the orchard. The plan of setting a given piece of ground should be well thought out and prepared before the grower begins staking for trees. A little headwork at this point will prove a time saver as well as getting the best arrangement of the trees.

After the land has been carefully laid off, holes wide and deep must be dug. A little well rotted barnyard manure put in the bottom of the hole and covered with a few inches of good surface soil will greatly aid the early growth of the tree and induce deep rooting.

Care must be taken in transferring the tree from the nursery. The trees must be put in line both ways and not set too deeply. Good surface soil with a little well rotted manure mixed with it must be carefully put around the ball and gently pressed down. Fill the basin with water, which will settle the dirt and drive out the air; straighten up such trees as may be leaning and out of line, and they are in shape to be left for a few weeks before a second irrigation becomes necessary. Remember that the initial treatment of any orchard has much to do with its growth, its power to resist drought, and its future productiveness. Therefore, permit no careless work to be done.

I shall touch but briefly only the salient points in the care of an orchard.

Cultivation.

I believe there is scarcely anything which exerts a more favorable influence on the quality of an orange than cultivation, and there is no other part of orchard work that is generally so indifferently done. The implement with which the work can be properly done may not always be at hand, and the man to operate it intelligently and honestly is likewise difficult to find.

There are several reasons, which I will not take time to mention, why greater attention should be given by citrus growers to cultivation. I will, however, briefly refer to two. One of these is the greatly improved quality of fruit secured by proper cultivation. It will unquestionably produce a smoother orange with more syrup and better flavor, and these are points which we should strive to obtain. The other is that vigorous cultivation at the time the fruit is forming will insure a larger setting than if neglected at this critical period. Cultivation is a stimulant and the tree needs a little help at this critical period. Cultivate often, deep and at the proper time after irrigation.

Pruning.

I find that some orchardists use the pruning shears very sparingly, if at all, claiming nature is her own best guide in the shaping and care of a tree in this regard. She endeavors with all her energy to make the most of the conditions into which ignorance or poor management has forced her. It is particularly distressing to see her thus struggling blindly with no intelligent hand put forth to direct or assist her.

This question, however, is better understood now than it was a few years ago. Experience has taught many lessons to the observing citrus grower. The novice in the business, of course, would realize that a tree should be kept clean of dead wood and suckers, but many old-time growers, if we are to judge from the appearance of some orchards, do not altogether observe this fundamental law. I do not believe it possible to grow the best fruit where the tree is not shorn of this material.

The tree should be opened so that free circulation of air can pass through it and under the lower limbs. The foliage of some varieties is inclined to grow thick and heavy. By opening the trees to the air and lifting from the ground the drooping branches, the quality of the fruit may be greatly raised and thus less liability to gum disease. Soil and climatic conditions must, however, control or regulate this to some extent. I am confident, however, that in most orchards satisfactory results can be secured by occasional vigorous pruning. There may be reasons for not doing this in certain sections, but I am persuaded that most orchards, even in such districts, would be vastly improved by judicious use of the pruning shears. Pruning must be intelligently done, however, never cutting without a reason. Knowledge of the natural tendencies and weaknesses of the variety in hand is necessary and a well defined appreciation of the end desired.

If properly pruned from the start, trees may be largely built so that they will need but little propping. Very heavy crops, however, will call for supports, which should be given before the limbs are too much bent with the weight of their load. The modern devices for propping greatly simplify this work, which heretofore has been both laborious and expensive.

Fertilization.

Among the numerous and perplexing problems with which the orchardists have to contend, none perhaps causes more weariness of mind than that of fertilization. We realize that as our orchards grow older, and in order to retain their vigor, we must supply them with plant food in proper amount and in condition for assimilation. I have no hesitancy in saying that in order to produce a fine quality of fruit in abundance, attention must be given to this question. Just what to do and when to do it is a question that cannot always be answered with satisfactory definiteness.

While I realize the value and importance of fertilization, yet the many unknown conditions prevailing in the use of any kind of compounded fertilizer, the uncertainty of its exact construction, combined with the great difference in soils, and the varied requirements in general treatment, make it difficult for me to attend to this important work with that degree of certainty I should like. I cannot deny, however, that we have gained much valuable experience in this important treatment of our orchards. We have learned the absolute necessity of supplying plant food to the soil if we would grow an orange crop annually. We have also learned that in ordinary soil and with trees over a dozen years old, a much heavier application of fertilizer is demanded than most of us have been in the habit of giving. I think that in many cases crop shortage, which is often charged to unfavorable climatic conditions, is due rather to a poverty of proper plant food in the soil.

Irrigation.

Many of us have learned to use irrigating water more wisely than in former years. The custom prevails in most sections of irrigating very frequently simply because the "turn comes around." This I regard as detrimental both to the permanent strength of the soil and to the production of the best quality of fruit. Irrigation should be thorough but not frequent. We are to understand, however, that all soils cannot be treated alike. For instance, it is injurious to light soil with sandy or loose subsoil to run water on it for any great length of time. This leaches the life out of the surface soil, washes away the humus and causes a weakness which soon shows on the trees. A grower should know the character of his soil to a depth of five or six feet. Unless he be acquainted with it he will not realize the damage he may do by improper irrigation.

Less frequent, but thorough irrigation and better cultivation, will not only produce a superior grade of fruit, but will keep the soil in better condition and avoid washing, leaching or baking. With ordinary soil while too frequent irrigation may be detrimental, there is little danger of it being too thorough. More water should be put in the soil than is usually the case.

Pests.

Citrus trees seem to invite numerous and troublesome pests. This is the case at least in most districts. These are not only a source of annoyance and expense, but if harbored will lower the quantity and quality of the fruit and finally entirely destroy the tree.

The black scale is very generally scattered over every citrus district, although the farther one goes from the coast the less troublesome it becomes. The red and purple scales are not unknown in many of our best orange sections. These are enemies that ought to receive prompt and vigorous attention wherever and whenever they appear. A grower will pay dearly for being indifferent in his efforts to destroy them. Fumigation is the only successful means that may be employed to do this.

Handling.

There are few growers but know how to do better work than is generally done. This is applicable to the handling of the fruit, as well as doing orchard work.

After a fine orange is grown it must be properly handled, and wise and prudent business methods used in marketing it. Growers in general have learned many valuable lessons along these lines during the past few years, and yet there are problems to be solved if we are to enjoy the degree of success I believe we are entitled to. A grower should be so familiar with his orchard that he knows just where the weakest fruit is grown, and then see that this is the first put on the market. By giving some attention to this feature, the entire crop may be marketed profitably.

While we grow a hardy orange in California, in this respect as in all others, and better than any other orange grown in the world, yet care in handling all along the line must be observed. To begin with, it must be properly picked. This demands great care. Since Mr. Powell's investigation into the damage done by clippers, there has been marked improvement in picking, there being at present but little clipper-cut fruit brought into the packing-houses. The genius of the inventor has given us a greatly improved clipper, but in the use of any kind, a certain amount of intelligence must be brought into play and the clipper itself must be kept in condition.

The same observation may be made of ladders. Some growers have the impression that any old thing upon which a person can climb will answer. A good ladder, however, is essential. It should be light. well balanced, and with comfortable steps, and should be long enough to reach above the trees, so that it will not break through the top.

Only picking bags of proper size and in good condition should ever be used and a regularly prepared picking box should be used in the field. Oranges cannot be handled with the necessary care in an ordinary packing box. In hauling from the orchard to the packing-house, wagons suitable and provided with springs should be used.

The whole process of the handling of the orange demands intelligent care and the grower or packer who would be successful must always bear in mind that a cut, puncture or bruise is an irreparable damage to the orange. No orange so injured should ever be put into a box for shipment. It is much cheaper to throw it away here, than to pay for packing and freight to some distant eastern market, only to have it thrown out there by some disgusted buyer.

After the fruit is brought into the packing-house, it should be kept for a time before packing. The length of time will depend upon the variety, its condition and the weather, both as to humidity and temperature. The fruit, however, should be properly cured before packing. This is imperative with the Valencia, and will prove a great aid in putting up a good pack. In this way also we are better enabled to eliminate injured fruit.

If the fruit is to be washed, as is sometimes necessary, this should be done as soon as it is brought from the orchard.

It should be our aim, regardless of expense, to put the fruit on the market in a perfectly sound condition. There is nothing that so demoralizes the market as decayed fruit, unless it be fruit that cuts dry. A few cars of oranges landing in New York or any other market and either showing decay or cutting dry will knock from 25 cents to 50 cents a box off the price of all sound fruit. Such conditions of course are fatal to the cars thus showing up. It is wise not only to use all possible care in handling the fruit, but to doubly insure against decay by shipping under refrigeration. Begin refrigeration early in the season and do not gamble by sending a few cars forward under ventilation in the hope of saving dollars. Almost every season we have a period of low prices caused solely by this false economy.

The season just closed was the most unsatisfactory and the least profitable we have had for a number of years. This was the result of the persistent shipment of frost-damaged fruit. Every time the market got strong and showed an upward tendency with satisfactory prices for good fruit, shippers would flood it with this worthless stock. They adopted the same tactics the boy does who wants to get into the circus without a ticket. He hangs around the entrance until the rush is on and then slips in along with the crowd. We overlook the action of the boy, nevertheless it was dishonest. Furthermore, that boy was less likely to be caught than the other fellow, for he was sure to be found out. We delude ourselves when we think we can fool the trade at the other end.

When this frost-damaged fruit was shipped it always knocked the market until good stock did not bring its real value and but little or nothing was realized for the poor stuff. That was poor business. The industry as a whole was thereby greatly injured, and the reputation of the California orange suffered. ''We don't like California oranges any more; they are too dry,'' was the common remark one heard in the east. One dealer told me that he had sold a car of oranges which he didn't believe contained a pint of juice. Many such cars were abandoned to the railroad for freight charges. A dealer in a certain city sold thirty such cars for the railroad companies. Hundreds of other cars, solely from this cause, brought less than freight and packing charges. Who was to blame? You answer.

Every orange offered to a consumer should be rich in juice and flavor. If such were always the case, the markets would readily take all the good fruit that California, north and south, is able to produce at good prices.

CHAIRMAN HUNT. Mr. Chapman said in the beginning of his address that he had not had time to prepare a careful paper, such as he would like to have done. I am wondering what he would have done if he really had had the time. This paper is now open for discussion.

MR. VAILE. Mr. Chairman, it seems to me that one of the most important subjects in citrus culture is the subject of irrigation, and possibly it is the thing about which the majority of men throughout southern California, engaged in the citrus culture, have the most trouble. I recognize fully that there are a great many different types of soils and each of these types require different methods of handling, but I have made one observation which we in Ventura County think important upon which I would like Mr. Chapman's opinion. Mr. Chapman has said that he has come to believe, along with others, that what we want now is not frequent irrigations but thorough irrigation. We want all of the soil wet to quite a depth, not necessarily the surface soil, but soil down until the roots are thoroughly wet. We are coming to feel from having carefully observed the soil immediately after irrigation and on other intervals until our next irrigation that in irrigating all of the soil at once, filling it full as it were of water, we stunt practically all of the feeding roots. The feeding fibres take on a darkish, almost a brownish appearance, within a day or two after such thorough irrigation. This gives more or less a distinct shock to the tree and it is not for a period of a week and sometimes longer than that that the fibrous roots begin to resume their normal appearance, and at the end of that time, a week or ten days, possibly even two weeks, the fibrous roots begin putting out new shoots. Some of the old roots do absolutely no further work. I do not know of any one who has tried the experiment on a large enough scale to make it applicable to general conditions, but the suggestion has occurred to some of us that possibly it would be better to irrigate the land at one time, leaving the roots say on one side of the tree free from this shock, and letting the roots on the other side of the tree receive the irrigation and then later on, at the end of a month or within a period that is deemed necessary, irrigate on the other side of the row of trees. I do not know whether others have observed this condition or not. Of course it would not be so apt to occur on gravelly soil as on our fine clay, silt, loamy soil, but this is something which I feel is worthy of consideration and I would like to have the opinion of Mr. Chapman and others on this subject.

Mr. Chapman. I do not have any of that quality of soil, and have had no experience with it, but I can always understand that if you let trees go until they absolutely need water and then give it to them in great abundance, why you are apt to shock your trees. You are apt to create a condition which you would not have if you regularly irrigated your lands.

Mr. Vaile. My idea in the matter is that the shock comes from the fact that the excess water filling the soil causes it to become too cold and damp for the feeding roots to thrive.

Mr. Chapman. You don't irrigate with ice water, do you?

Mr. Vaile. It is cold water, comes from the river. I think people don't irrigate enough. Don't let your orchard need irrigation. Some people say our trees don't need so much irrigating, and so they don't do it. Then they put water on and you naturally have a shock which is detrimental.

Mr. Schulz. I would like to ask Mr. Chapman about his method of fertilizing.

Mr. Chapman. As I said before, that is a very difficult proposition. I buy all my fertilizer in what is called car lots of tankage. I get a high grade tankage, and buy my nitrate of soda and superphosphates and potash in the same way, and put them on one at a time, usually in the spring the heavier, and later in the summer the superphosphates and potash.

Mr. Schulz. What time do you put on the nitrate of soda?

Mr. Chapman. Put on the nitrate of soda usually at the time the fruit is in blossom, after it has been in blossom a time. It is of great assistance in setting the crop of fruit.

Mr. Schulz. Do you ever use sulphate of iron?

Mr. Chapman. I used that once some years ago, and apparently it didn't do much good, didn't get any beneficial results and proved somewhat troublesome and hard to get, expensive, and I didn't see any use in using it.

Mr. Banks. I just want to ask a question. I think without a doubt that California is pretty well agitated along the idea of soil fertility. We produce groves and know how to plant trees and how to grow them. We have all that under consideration. If I did not misunderstand Mr. Chapman, he is a shipper. What we all want is a feasible way whereby the producer can get more for his crop by marketing or otherwise—so that he can market his crop to the best advantage and at the lowest possible cost. That seems to be about the biggest point that the growers have got in California.

Mr. Chapman. I agree with you, that that is a very important question. It is perfectly useless to grow oranges and get nothing for them. In southern California we have the Fruit Growers' Exchange, which is a splendid organization, and it does not conflict in any way with the growers there, and does them good, especially the small growers. This exchange has been in existence for five years now, and the growers get full value for their oranges. Of course the Fruit Growers' Exchange or any other organization could not get full value for frozen stuff or decayed fruit or anything of that kind. When you get good fruit on to the market you can get prices at this exchange. I am not in that combination, but I do recommend it to small growers. I have enough fruit to have a combination of my own. I begin shipping along perhaps in December, perhaps in January, and continue until the middle of November, shipping steadily, and in that way I can keep my fruit on the market. Now, the point I would like to make is this, that the better quality of fruit, the cleaner the fruit is, the better prices you will get, and the trouble is that many men are shipping inferior fruit into the markets. That does not only apply to the orange, but it applies to every character of fruit that is shipped out of California.

Dr. Cook. How much of this nitrate of soda do you apply to the tree?

Mr. Chapman. On full-bearing trees, twelve and fourteen, fifteen and eighteen years old, put two and a half to three pounds. I would not put too much in a single application, it would be too heavy. If you put six pounds on, put it on in two applications about thirty days apart. I never use nitrate of soda in the fall, always in the spring.

A Member. What is your objection to small lots of fertilizer?

Mr. Chapman. Haven't any objection, only I happen to have enough acreage to warrant my buying carload lots in everything. I can buy it cheaper that way, get better rates.

Dr. Hunt. It is now time for closing, but Dr. Cook, the Commissioner, desires to make some announcements.

Dr. Cook. In regard to the Committee on Resolutions, we have enlarged that committee and Mr. Chapman is chairman, and it will meet right after this meeting. That committee is now as follows: Mr. C. C. Chapman, chairman; B. E. Hutchinson, Russ D. Stevens, A. G. Schulz, John Graf, F. T. Swett, W. T. Kirkman, Geo. Roeding, Henry W. Kruckeberg are the members.

EVENING SESSION.

The convention was called to order by Dr. Cook as chairman.

Chairman Cook. We now have a very important address on the quarantine work of the State Commission of Horticulture by the chief deputy quarantine officer, Frederick Maskew.

WORK OF THE QUARANTINE DIVISION OF THE STATE COMMISSION OF HORTICULTURE.

By Frederick Maskew, San Francisco, Cal.

(Stereopticon lecture.)

Mr. Chairman, Ladies and Gentlemen: For many years past it has been the custom of those called upon to address the assembled fruit growers at their annual conventions upon matters dealing with the horticultural quarantine service, either to present a long list of insect pests and plant diseases existing in other countries and which are likely to arrive in California at any time, or else to recapitulate a similar list of those that have already been intercepted. Having been detailed by the State Commissioner of Horticulture to address the members of this convention upon the subject mentioned, and not caring to go over the same old ground, and also thinking that perhaps it might interest you to see for yourselves how this quarantine work is actually performed, I have prepared a series of lantern slides illustrating some of the leading events that take place every day in the interception and inspection of horticultural material entering the State of California at the Port of San Francisco and its environs.

Map of California. (Fig. 322.)

It is not necessary to tell any one here present what territory is represented by this outline. There is only one California. The purpose of the picture is an attempt to show the system that adequately protects its horticultural and agricultural interests. The counties that are darkly shaded have County Horticultural Commissioners; practical men with a good working knowledge of what their official title implies—horticulture, and its adjunct, the injurious insects and diseases of the products peculiar to their own counties. Thus from the map we see that out of a total of fifty-eight counties in the State we have forty-two in which are to be found active working county commissioners. These same officers are

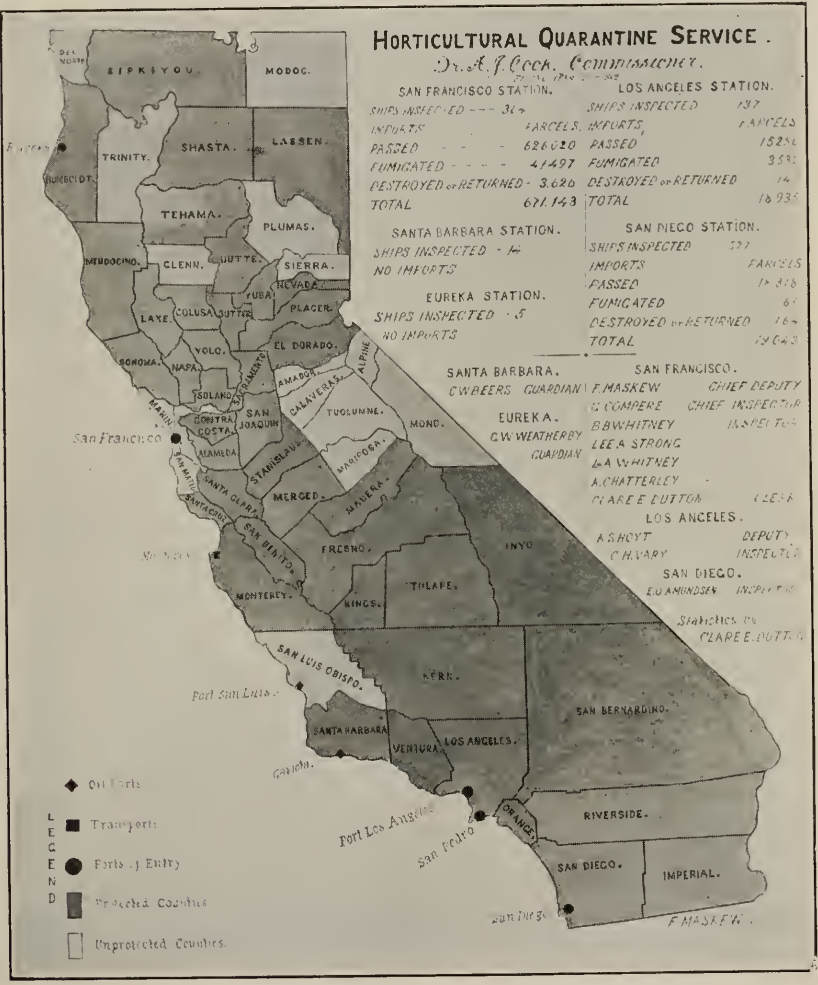
HORTICULTURAL QUARANTINE SERVICE.
Dr. A. J. Cook. Commissioner.
SAN FRANCISCO STATION.
SHIPS INSPECTED
IMPORTS PARCELS.
PASSED 626020
FUMIGATED 41497
DESTROYED or RETURNED 3.626
TOTAL 671.143
LOS ANGELES STATION.
SHIPS INSPECTED 137
IMPORTS PARCELS
PASSED
FUMIGATED
DESTROYED or RETURNED
TOTAL
SANTA BARBARA STATION.
SHIPS INSPECTED 14
NO IMPORTS
EUREKA STATION.
SHIPS INSPECTED 5
NO IMPORTS
SAN DIEGO STATION.
SHIPS INSPECTED
IMPORTS PARCELS
PASSED
FUMIGATED
DESTROYED or RETURNED
TOTAL
SANTA BARBARA.
C.W. BEERS GUARDIAN
EUREKA.
C.W. WEATHERBY GUARDIAN
SAN FRANCISCO.
F. MASKEW CHIEF DEPUTY
G. COMPERE CHIEF INSPECTOR
B.B. WHITNEY INSPECTOR
LEE A. STRONG
L.A. WHITNEY
A. CHATTERLEY
CLARE E. DUTTON CLERK
LOS ANGELES.
A.S. HOYT DEPUTY
C.H. VARY INSPECTOR
SAN DIEGO.
E.O. AMUNDSEN INSPECTOR
Statistics by CLARE E. DUTTON
DEL NORTE
SISKIYOU
MODOC
TRINITY
SHASTA
LASSEN
HUMBOLDT
Eureka
TEHAMA
PLUMAS
MENDOCINO
GLENN
BUTTE
SIERRA
NEVADA
YUBA
PLACER
LAKE
COLUSA
SUTTER
EL DORADO
ALPINE
SONOMA
NAPA
YOLO
SACRAMENTO
AMADOR
CALAVERAS
TUOLUMNE
MONO
MARIN
SOLANO
CONTRA COSTA
SAN JOAQUIN
San Francisco
ALAMEDA
STANISLAUS
MARIPOSA
SAN MATEO
SANTA CLARA
SANTA CRUZ
MERCED
MADERA
SAN BENITO
FRESNO
INYO
MONTEREY
KINGS
TULARE
SAN LUIS OBISPO
Port San Luis
KERN
SAN BERNARDINO
SANTA BARBARA
VENTURA
LOS ANGELES
Gaviota
Port Los Angeles
San Pedro
ORANGE
RIVERSIDE
SAN DIEGO
IMPERIAL
San Diego
F. MASKEW
LEGEND
Oil Ports
Transports
Ports of Entry
Protected Counties
Unprotected Counties

FIG. 322.—Map of California showing work of the State Horticultural Quarantine Division. (Maskew, M. B., Hort. Com.)

also state quarantine guardians, with full power to carry out the provisions of the state quarantine law—one of the most powerful instruments enacted by our lawmakers. This gives them control of all horticultural products entering their county from outside the State lines, and the records show that they have in many instances prevented by their diligence, the introduction into the State of destructive insect pests and plant diseases.

With the exception of San Luis Obispo, San Mateo, Marin and San Francisco, the counties that have not quarantine guardians are chiefly mountain counties where horticulture is not generally practiced and where horticultural imports from outside the state lines are a minor quantity.

It is through the medium of the coast ports that the danger of introducing the fruit and melon flies is the greatest, and it is often perplexing to the fruit growers how the hundreds of bays, harbors and indentations on a coast line of approximately 1,000 miles in length can be safely watched and guarded at all times. The provisions of the maritime law simplify this procedure. Vessels arriving from points outside the United States coast line, no matter to what point in California they are consigned, must of a necessity first come into a port of entry and submit their papers to the Federal customs. There are five such ports of entry on our coast, and I have indicated them upon the map: Eureka, San Francisco, Port Los Angeles, San Pedro, and San Diego. At each of these ports the State maintains a station of its quarantine division, and each vessel upon arrival finds not only the Federal customs officer ready to appraise and collect duties, but also a State quarantine officer ready and competent to pass upon the general health, cleanliness and desirability of whatever horticultural products the ship or the members of its company may have brought to our shores.

There is one exception to this matter of ports of entry. I have indicated these upon the map as ''oil ports.'' Occasionally, vessels arrive at these ports from points outside the United States coast line, but they are in every instance ''oil tankers'' with no facilities for general freight and no license to carry passengers. At Gaviota the State Quarantine Guardian of the Santa Barbara Station meets, boards, inspects and reports upon all ships arriving at that port from outside the state lines. At Port San Luis we have no inspector, but to compensate for this the company owning the vessels making this a port of call has issued a general order to all commanders prohibiting the bringing into this port of any fruit or vegetables either as ship's stores or personal property that may have been obtained at any Hawaiian points.

Look well at the map before I remove it from the screen, and try and realize what it means to have every railroad station, every express office located in that shaded area in touch with a horticultural officer. Read the number of ships inspected and the volume of imports examined at the different stations, and the extent of this service will commence to grow upon you.

General Army Order No. 3.

This is a photographic copy of General Army Order No. 3. I have introduced it here for an especial purpose. On the map that has just been removed from the screen Monterey was marked as a port of call for United States Army transports, but the regular army transport docks are located at San Francisco. To our personal knowledge certain poorly informed persons circulated the report that vessels from foreign ports were landing at Monterey and that no official was present to prevent the fruit flies from being brought into the State at that point. Such are not the facts. United States Army transports from Manila via Honolulu are the only vessels arriving from fruit fly regions that land at Monterey, and only one of these has done so during the past fiscal year. Any one who has knowledge of how army orders are expected to be obeyed need feel no apprehension on this point, and our own experience in searching every transport that has arrived at San Francisco since this order was issued, proves clearly that it produced the desired effect.

Map of the World.

Every locality indicated by a name on this map excepting only San Francisco, is known to be infested with different species of fruit flies. At the quarantine office we have records of all these several places; of the various kinds of fruit infested; of the different species of fruit flies infesting the same, and in the great majority of instances specimens of the actual flies themselves. The specimens were collected, their method of attack studied and the data furnished by George Compere. This map is shown here for a dual purpose; first, to show to you the different steamship routes having connections with California and the fruit fly regions at which they call during each voyage. To begin with, here is the route from the Hawaiian Island direct. Hilo is now as badly infested as Honolulu. Over this route comes at least one ship a week of the Matson Navigation Company's fleet, and one ship a month of the Oceanic Steamship Company's fleet. From Sydney via Wellington, Rarotonga and Papeete comes one ship a month of the Union line. These vessels do not touch at Hawaiian ports, but the point of departure, Sydney, at which they obtain their supplies, is as badly infested with the Mediterranean fruit fly as is Honolulu, and further, they call in at Rarotonga where there are at least three forms of fruit flies at work on the fruits of that island, one of which, *Dacus melanotum*, attacks alligator pears very badly. The next stop is Papeete on the island of Tahiti, and at quarantine we have not as yet been able to find any evidence of fruit flies in material from that location. This fact complicates matters a great deal, as it is practically impossible to tell from a superficial appearance the difference between fruit from Rarotonga and that from Papeete, so the ruling has been adopted at quarantine that no fruit shall be landed from these vessels excepting only that set forth on the ship's manifest, which is a sworn statement of the port at which it was taken on board. From Sydney via Samoa and Honolulu comes one ship a month of the

Oceanic Company's fleet. Here, again, are two ports badly infested with fruit flies. This route from Sydney via Fiji, Honolulu to Vancouver, is also a monthly run and concerns us only indirectly, but it may result in concerning the territory of Hawaii very much. There are at least three forms of fruit flies here, some of which attack pineapples and bananas very seriously, and they may find their way into the Islands as did the ones that are already there. From Hongkong via Yokohama and Honolulu comes one ship about every twenty-one days, of the Japanese Mail line—the melon fly to start with at Hongkong and much worse at Honolulu. The Pacific Mail Company averages three ships a month from Manila, Hongkong, Nagasaki, Yokohama and Honolulu—fruit flies at every port of call excepting only Yokohama. Once a month comes a United States Army transport from Manila via Nagasaki and Honolulu—fruit flies at every port of call; at least twelve ships a month, all of which stop at Honolulu.

From Balboa via all Central American ports come at least four ships a month of the Pacific Mail—the Mexican orange maggot at every stop. From Salina Cruz via San Diego the American-Hawaiian Company bring in at least four ships a month. This makes a total of twenty regular liners a month that come on schedule time. Here is a route from Hilo to Salina Cruz in Mexico. An American-Hawaiian ship covers this route once a week. This has been a source of great potential danger. At Salina Cruz there is no inspection of ships; the vegetation comes down to the water's edge; a Mediterranean fruit fly will lay its eggs in a cactus fruit as readily as in an orange; cactus occurs continuously from Salina Cruz to California; the route is not impractical to a strong winged insect like a fruit fly, and there you are—a chance once a week to get a start. Compere and I smoked a good many pipes trying to find a way to close this avenue of entrance, and at length the opportunity occurred. A ship bound from Hilo to Salina Cruz was recalled by cable and returned to San Francisco. The condition of the vegetables in the ship's stores amply verified all we had imagined. The case was laid before the general manager of the line in all its different bearings, he saw the point clearly, issued an order to all commanders in the fleet to purchase sufficient stores at home ports to make the voyage, not to purchase nor allow to be brought on board any fruit or vegetables at any Hawaiian port. This has at least relieved the situation.

From Europe via the Straits of Magellan come the liners from Europe, and these, together with the tramp steamers from all over the world, bring the average of ships arriving from foreign ports and which come under our jurisdiction up to about thirty a month.

The second purpose for which I compiled this map was to endeavor to prove to you that a great deal of misapprehension is held in relation to the Mediterranean fruit fly. It has been asserted in print that this insect is essentially a tropical form and would not be able to establish itself in California if introduced. Look well at the map—it is compiled from the latest data. The black circles indicate regions where the Mediterranean fruit fly exists; the black diamonds, other forms of fruit flies. Between these two parallel black lines are located the tropics. How many circles can you find in the tropics? Three: Hawaii, Teneriffe and St. Helena Islands surrounded by ocean influences that virtually make them semi-tropic. Look along both shores of the Mediterranean and see the black circles—practically the same latitudes as California. As soon as you enter the tropics you find other forms—a *Dacus* here in Senegal and also in the Sudan. In the southern latitudes it is the same. At Cape Colony *Ceratitis,* but immediately across the line *Dacus* sps. at Damara and at Mauritius. In the tropics of Central and South America *Ceratitis* does not occur excepting at Sao Paulo in Brazil, which, you see, is right on the line. And now in Oceanica, Australia and India. Down in Australia, in latitudes comparing with those of Europe, we have *Ceratitis capitata* at its very worst, but in Queensland, as soon as we cross the line, other forms of *Dacus, Trypeta* and *Rivellia* take its place. Throughout Oceanica and India you see the black diamonds representing other forms of fruit flies, all of which I have a full record of, but you do not see the symbol that represents *Ceratitis capitata.* This should be sufficient evidence that this pest not only thrives in, but seems to prefer, climates similar to our own, and if in reality it is only "a ghost" perhaps we had better continue in our endeavors to keep it "laid."

San Francisco Guide.

A few minutes ago I was speaking of the different steamship routes entering the port of San Francisco, and I have introduced this picture, which represents the San Francisco *Guide,* to explain to you how the quarantine officers are enabled to keep in touch with the movements of vessels at sea. There is one thing a master of a ship must do before he sails, no matter what else he may neglect, and that is to take out his clearance papers. Failure to do this is likely to result in his making the acquaintance of a gunboat or a cruiser a few days later. The taking out of these papers becomes a matter of record, and the collectors of marine news promptly publish the same. The movements of all ships on the way to San Francisco are published in the *Guide.* If a Cosmos liner leaves Hamburg for San Francisco to-day, we find it recorded in the paper to-morrow, and so on with all vessels concerned. The regular liners come on schedule time, and the time of their arrival is set down on the left-hand side each day under its proper date. It is amusing to watch the boys come into the office in the morning (while as a matter of fact each one has memorized the arrivals for the week), the first thing all of them do is to go to the *Guide* with the statement "what's on the board for to-day?" The comments that usually follow illustrate the fund of information to be found on this single sheet. For instance, some one will turn over the paper and, after looking over the reference column, will remark: "Say, that Cosmos liner coming up from Punta Arenas has been into Mazatlan." This fact invests the arrival of that ship with an entirely different amount of importance. Mazatlan means Mexican orange maggots. And so on, each time a ship en route for San Francisco makes a port of call it is recorded, and by studying this paper the quarantine officer can actually keep in touch with every movement of each ship. You will readily see how this helps to simplify the work.

Map of San Francisco.

This is a picture of San Francisco, and I think it is a good one; however, the present purpose is not to display its civic beauties, but to illustrate one more cog in the machinery of the quarantine service. For information as to the actual arrival of vessels, the State subscribes to both the marine exchanges. Two observers are maintained by this department; one is stationed here at the point and one here inside at the Federal Health Quarantine Station. The range of vision from the outside station is perhaps twenty miles on a clear day, and as soon as an approaching vessel is near enough to be recognizable the observer calls up all those on the line and reports, for instance, as follows: "Sierra passing in." The vessel now comes on up the bay, and, arriving at the proper location, drops her anchor and awaits the arrival of the Federal Health Officer. The inside reporter now calls up on the phone, "Sierra at quarantine." This is followed by the final call, "Sierra going to the dock." As a result of experience we are able to calculate the time that will ordinarily elapse from the first call until the ship will be at the dock, and arrange for the performance of other duties in the mean time. Should the vessel reported be outside the regular liners, a reference to the *Guide* shows where she is from and to whom consigned and at what pier she may be expected to dock. Ships passing in during the night must remain at quarantine in the bay until sunrise, and these arrivals are reported by phone to the boarding inspectors at their residences.

Quarantine Office.

I have introduced this picture of the quarantine office at room 11 in the Ferry Building, San Francisco, to show that during working hours, should all the force be scattered at different points on the dock and railroad yards inspecting arrivals of material, the clerk is always present to receive and answer phone calls, and keep the inspectors informed of the movements of vessels so that they may be prepared to meet the same without any unnecessary loss of time. The office also contains a very interesting museum, comprising the material that has been intercepted at quarantine during the past twenty years, and is also a clearing house for much general information on insect pests and plant diseases, as well as upon matters concerning the regulations covering the movements of horticultural imports.

Launch.

Now we are getting closer to the actual work. This is the launch "Argonaut," maintained for the use of the Federal doctors. This boat leaves the dock every morning in the year, rain or shine, at the moment of sunrise, which ranges from thirty-four minutes after four in June, to fifteen minutes after seven in December. There is an imaginary line across the bay over which no vessel from any port outside the United States coast line dare pass, nor must any one or anything either leave or be taken on board until the Federal doctor has inspected and passed the vessel. This applies equally to vessels from island possessions as to those from foreign ports. In the matter of vessels from foreign ports, the United States Customs boarding officers go out in their own boat and take charge the moment the doctor passes the vessel. No person or article is permitted to leave without their inspection, and with such vessels our work does not commence until the dock is reached.

With vessels from Manila or the Hawaiian Islands the procedure is different. With the one exception of passing the doctor, persons may travel from our island possessions to the United States with as little hindrance or interference as from San Francisco to Oakland. Once the doctor's yellow flag comes down, no further attention is paid to the ship, its contents or the passengers it carries by any official, excepting the State Quarantine officers. To enable us to promptly take charge we have been given the courtesy of using the doctor's launch for the purpose of getting on board these ships out in the stream.

Boarding.

Here we are—the first act of authority in executing the provisions of the state quarantine law, Compere boarding the steamship Sierra. Dr. Drew has decided the ship's company are all in good health, the yellow flag comes down, the horticultural officer goes on board, the anchor comes up and away the ship goes to dock. No more restrictions on anyone or anything, so far as customs, immigration or health officers are concerned. We hold that there is just as much danger from fruit landed between the anchorage and the dock as there is in that which actually passes over the dock itself, and to prevent the possibility of this without proper inspection, a boarding officer goes on board before the doctor leaves the ship.

Inspection on the Way.

On the way up stream the inspector takes a look through such vegetable or fruit lockers as may be located on deck, to see if any remnants of the ship's stores have been overlooked. Compere has evidently found something that did not suit his ideas of a clean ship and has just thrown it overboard. It was unquestionably contrabrand, but had it been actually infested, depend upon it he would have steamed it before it was thrown overboard.

Searching the Passengers' Baggage.

This is the crux of the situation, in so far as the Mediterranean fruit fly is concerned. Unfortunately, I was unable to obtain good negatives of this most important part of the work. The movement of all concerned was too continuous for a time exposure and the light too poor for a snap shot; however, you can obtain a slight idea of the procedure. The steamship companies, at their own expense, voluntarily fence off an inclosure with the panels you see and also rig sorting tables. One of our men keeps the gate and all hand baggage, suit cases, trunks and parcels that have been in the cabins during the voyage are opened and examined, the red tag of the quarantine service is attached, and this must be in evidence and submitted to cancellation before the gateman will pass it out. The trunks that have been in the hold of the ship throughout the voyage are not searched as a rule. However, there have been several instances in which we had reasons to believe that attempts had been made to pass on shore baggage that had been in constant use in the cabins, together with that which had been in the hold the entire voyage. In these instances every piece was searched before it left the dock. Also in every instance an inspector watches the hold baggage as it comes on shore and any boxes or packages that appear as though they might contain articles other than clothes are promptly opened and searched.

This searching of baggage is the weak spot in the quarantine service under present conditions. It has been repeatedly shown that we have no right by any law to open and search this baggage, and that in doing so we are merely exercising a privilege acquired by a concession. There are no commercial shipments of any of the hosts of the Mediterranean fruit fly. The ship's stores can always be controlled, but the true and immediate source of danger is the possibility of a passenger carrying infested material to some country home. It is to be hoped that both the State and Federal authorities will devise some police regulations that will adequately cover this situation.

It is but fair to state at this point that the officials of the steamship companies plying directly between Honolulu and California have done all in their power to co-operate with us in this matter of local passengers and their baggage.

Bananas on Deck.

As soon as the inspection of passengers' baggage is finished the inspectors commence to search the ship. Some look through all the cabins to see that no contraband fruit has been left scattered around by the passengers when they packed up, others search the cool rooms of the ship, where the fruits and vegetables used on the tables have been stored during the voyage. The picture on the screen shows that part of the ship alloted as lounging room for the steerage passengers. They sit around on these hatches and companion way, and from the débris we find scattered around consume a great deal of fruit on the way up from Honolulu. The bunches of bananas you see piled up here are covered with canvas during the time the vessel is at sea, but a close examination always shows a number of apple cores and orange skins, and we have found mango skins collected at the bottom edges of these canvas coverings, where the same have been pushed aside in sweeping the decks. This débris is always picked up and examined, and if suspicious the bunches of bananas that are anywhere near it are thoroughly examined for any possible pupa of fruit flies.

Bananas on the Dock.

When the bananas are taken out of the ship they are segregated into different lots, representing the consignees, and are counted and examined before any are permitted to be taken away. This picture was taken during the noon hour. It would be impossible to obtain a picture during working hours, owing to the number of men and teams constantly moving across the line of sight. Each bunch, as you see, is wrapped in rice straw, and each individual bunch carries an inspection tag which indicates the district in which it was grown and is an assurance that the district mentioned is away from the immediate infestation of fruit fly. The method of inspection followed by the State Quarantine officers at the present time is as follows:

The binding strings are cut, the outer wrapping of rice straw is pushed to one side and the kind of inside wrapper determined. No sacks of any kind are permitted. Paper must be the only kind of material used for an inside wrapper. The next point to determine is what is technically termed as dry ends. A process in banana culture is the rubbing off of all remnants of the dried blossoms from the ends of the fruit. This causes the ends to harden over and remain intact. If omitted, decay is likely to set in and furnish a possible medium for the fruit flies to deposit their eggs. With these facts determined—paper wrappers and dry ends—the bananas are released from the dock. One inspector is especially detailed to follow the bananas to the curing rooms and inspect them thoroughly after they are unwrapped and hung up. He devotes his entire time to this and reports specially upon this matter of bananas each month. So far no evidence whatever has been found of fruit flies on any of this material.

Fumigating Pineapples.

All pineapples arriving from Hawaiian points are found to be infested with an occasional mealy bug or specimens of *Diaspis bromeliæ*. Every case of pineapples destined for points in California is fumigated before being released from the dock. I have often computed the dimensions of the pile and the dosage used, and can assure you that never less than 3 ounces of cyanide to each 100 feet of space inclosed is used in these operations. The tents you see here in the picture are also oiled, so that you present who are accustomed to fumigate citrus trees can appreciate the severity of the dose applied. I have my doubts if even this strength would destroy the fruit flies if any were present in the pupal stage, but it is the best preventative treatment we know of or can apply at the present time.

Pacific Mail Liner.

Here is a picture of a Pacific Mail liner that has arrived from many foreign ports, touching at Honolulu on the way. We did not have to board this ship in the stream; when the doctor's yellow flag came down the Immigration officers and the Chief Boarding officer, together with at least six watchmen of the Federal Customs, went on board and brought her up to the dock. The cabin passengers have landed—their baggage has been searched by the Federal Customs, and whatever horticultural products of any kind found in the same were turned over to the State Quarantine officers. We are now ready to go on board and see what the steerage passengers have brought over with them. But before we go to make a search, take a good look at this fabric, 616 feet long, a displacement of 27,000 tons and a carrying capacity of nearly 14,000 tons, accommodations for 1,000 passengers and crew list of 300—1,300 souls to feed and house. This is equivalent to a small town, but a small town is no comparison; a better one would be a section out of the heart of a great modern city. No café has a more extensive or varied menu than these great liners. Should you see fit to order frogs legs, there are plenty of live frogs on board in a tank kept for that purpose. You may order Chinese pheasant, venison, or anything a fanciful palate may crave, and be assured that it will be forthcoming; so with the fruits and vegetables. Fruits that it is impossible to find on the market any where in the United States may be had in these ships. Mangosteens, papayas, mangoes, avocados, etc., are always available. Think what this means to those whose duty it is to search the ship and find what may be left, and think also what it means to the owners, compelled in the interest of their passenger business to cater to every whim of the globe trotters that patronize these ships; persons who, in the main, have no permanent country nor any particular interest in protecting the products of the same, whose sated appetites and jaded palates respond only to the sensations produced in their esophagus by the wriggling of the fruit fly maggots that invariably infest these tropical fruits, which the steamship companies are practically compelled to have on hand at all times during the voyage, and which the State of California prohibits their bringing within the three mile limit. To their great credit be it said they are at a great expense complying with the provisions of the law and co-operating with the quarantine officers.

Steerage Passengers.

Here are a few of the steerage passengers and some of their baggage. All of us here present have moved our possessions more or less at different times, and know what store we set on our Lares and Penates. So with these poor passengers. All of these packages you see, every one of them, have got to be opened up, emptied out and examined. Here is where you get a glimpse of some side lights on the great Drama of Life. To prepare the passengers for the possible action of the State Quarantine officers we have prepared printed lists of contraband fruits.

Notices.

Here they are: the Chinese characters are a literal translation of the notice as printed in English. Each ship, on sailing day from San Francisco, is furnished with a supply of these printed notices in both languages. These are distributed by the ship's officers on the return voyage, after the vessel has left Honolulu. We have taken great pains with this educational feature of the quarantine work. This illustration represents but one feature of the same, and it is a great pleasure to state that both the officials of the different companies and also the officers of the several ships have heartily joined in this attempt at proselytism.

Inspecting Steerage Baggage.

Here we get a little closer to that indescribable mass of baggage you saw in the last picture. A Customs officer is given a certain number of passengers—a Quarantine officer goes with him. The owner opens each package, spreads out its contents, dutiable goods are assessed, contraband fruits are confiscated, pass tags are issued, and in due time the whole seance is over.

Lockers.

Searching the ship and its store rooms for contraband fruits and vegetables is the next work for quarantine inspectors. It will be well to grasp the fact at this time that neither the Federal nor State governments can legislate against the high seas. The exigencies of passenger traffic demand a food supply, and there is no apparent legal way of fixing the kinds of material to be used for food. The steamship officials take on board what experience has led them to expect will be needed, but the state law clearly sets forth what they shall not have on board when they enter within its lines of jurisdiction. Stringent orders have been issued by the directors of these lines to all commanders and pursers to see that all remnants of contraband fruit and vegetables are thrown overboard before the harbor is entered. As a rule these instructions are enforced, but it is in the final act that violation sometimes occurs. It invariably occurs that the actual throwing overboard of this material devolves upon a Chinaman. There are probably 250 Chinamen in the crew of this ship, and the temptation is great to appropriate and secrete some of this material. Fortunately, none of these Chinamen are allowed to leave the vessel. The stolen material is hidden down between decks, and if any escapes the search there is no danger of its getting on deck, much less on shore. A bad feature of some of these ships is the open work vegetable lockers on deck, the same as shown here on the screen. The inspectors have evidently found some remnants of contraband material and are looking for actual maggots. Here is the point: the material found will be promptly destroyed, but if larvæ of fruit fly is found the locker must be fumigated with live steam.

Gangway.

Here is the check and key to the inspection of the ship. Once the passengers and their belongings are on shore, all coming and going to and from the ship to the dock must pass through this port. There is no other way available. A Federal watchman is on duty night and day. They all have orders not to pass any horticultural material without a state pass, and to destroy the pass tag in each and every instance. Not alone the parcels he may have with him, but the person of every individual (even the horticultural inspectors), is searched by these watchmen.

Manifest.

In the earlier part of this talk I made mention of a manifest. To make the term clearer I have introduced a page of an original manifest here on the screen. A manifest is a sworn statement by the master of everything the ship contains, where from and who for. Failure to enumerate any article on this list is punishable with a heavy fine. The state quarantine law provides that any person, firm, or corporation who shall bring into the State of California any horticultural products shall immediately notify a quarantine officer. To comply with this, vessels, upon arrival, furnish the quarantine officer with a special manifest of all such material contained in the ship. Upon the receipt of this it then becomes the duty of the quarantine officers to locate, open and inspect this, then notify the owners of the condition, and, if found necessary, hold the same until it is adequately disinfected.

Freight.

There is an average of 7,500 tons of freight that passes through this warehouse each week in the year; 6,000 tons from Oriental ports, 1,500 from Central American ports. The picture on the screen shows the quarantine inspectors locating in this heterogeneous mass the articles set forth on the manifest as coming within their jurisdiction. This picture was taken during the noon hour, it being impossible during working hours owing to the large number of men at work, to obtain a photo.

What He Was Looking For.

This is one of the things the inspector was looking for in the last picture—Chinese sweet potatoes. The particular one here in this picture evidently believes that inspect means to examine, from the way he is investigating the interior of these potatoes; however, it is a fact that all sweet potatoes arriving from Chinese points since last August have been confiscated and destroyed, and it is simply a matter of patient search to obtain sufficient evidence to justify the act of confiscation.

This is what he found in the sweet potatoes: An oriental weevil, very much like an ant in appearance—*Cylas formicarius* it is named. It has not yet been reported from any of the fields or gardens of California, and from the insidious manner in which it destroys the interior of the potato it is unquestionably a pest we do not want.

Moana's Deck Locker.

Here again is another feature of the quarantine work. This picture represents the upper deck of one of the liners from Australia. Starting from Sydney in a territory where the Mediterranean fruit fly is at its worst, every box of fruit and every sack of vegetables taken on board for ship's use is a potential danger. This locker here shown is used for storing such fruit and vegetables as are likely to be consumed during the early days of the voyage. Should there be any fruit flies in the material that have attained their full growth, they may leave the packages and pupate in the crevices of this locker. Look at the open grating. What better opportunity for escape would an adult want than through the openings between those slats. Compere is exceedingly wise in the ways of fruit flies, and this particular locker is his pet aversion. While we have not as yet found the real article, we always manage to find reasons why this locker should be thoroughly scalded.

Cocoanut Sacks.

This is part of a shipment of 2,000 sacks of cocoanuts from Rarotonga. There are several species of fruit flies at work on the island, and all fruit from that country is barred out under the provisions of section No. 5 of the horticultural quarantine law. In this shipment the inspectors found some nuts that were infested with maggots. A study of these larvæ soon showed that they did not belong in the family *Trypetidæ,* but we take no chances on any maggots found working in fruit, and while it was accepted at the time that they were perhaps a result rather than a cause, the shipment was held up. The consignees proved to us that they were prepared to steam the contents of these sacks at high pressure, and with the proviso that they do this together with the sacks, under the supervision of a quarantine officer, the shipment was released. This steaming was done in a retort with live steam under sixty pounds pressure to the square inch for an exposure of forty minutes.

Steamed Sacks.

I have shown you this picture just to verify the statement that these 2,000 sacks were steamed. Here you see them just as they were on Sansome street drying, and the dry ones being baled. I wish it were possible to subject each individual thing that arrives in San Francisco from fruit fly countries to a pressure of sixty pounds of live steam for an exposure of forty minutes. I sure would sleep much sounder.

Railroad Work.

It must not be supposed from all that has gone before, that the duties of the quarantine officers are solely concerned with imports arriving by sea. On the contrary our record for the past year shows that the San Francisco division has handled 298,763 parcels of horticultural material that has entered the limits of our local jurisdiction by rail. Here is a sample of this work on the screen—three carloads of plants and trees from Holland via New York. I will not weary you with any detailed description of this phase of the work further than to assure you that, as you can see, each individual tree or plant is separately examined.

Record.

This is a page taken from our daily record and reproduced here to show you how account is kept of each transaction, and also who is responsible for the action taken in each individual case. At the bottom here you see the item, "resacked and old sacks sent to the incinerator to be burned." Compere and I have found the pupæ of the Mediterranean fruit fly attached to the seams on the inside of old gunny sacks that had come from Honolulu, and from that day on I have refused to pass any article from Hawaiian points that was contained in a sack that was not new. It makes no difference what it is, resack and burn the old sacks, or I send it back. That is my ruling. Gentlemen, I am convinced that every sack, box, bale, package, every ship, every person that comes from Honolulu to California is a potential danger to the greatest of our industries, and to the very extreme limit of the powers invested in me, as quarantine officer, I am going to minimize this danger. No old sacks.

A Mango. (Fig. 323.)

This is an actual photograph of a mango; one of many that have arrived at San Francisco since I have had charge. Yes, it came from Honolulu. The lot that this was taken from came up in the Sonoma on August 15th. Its condition may be accepted as typical of mangoes from fruit fly regions. Look at the maggots. There was no evidence of this condition on the outside of this specimen, for I looked it over very carefully. The mango is typical of its native tropical surroundings. Its smooth glowing golden skin covers and hides a mass of festering corruption that cannot be realized until investigated. I have tried hard to analyze what is about the mango that seems to seduce otherwise fair-minded people away from all sense of public duty and protection of home industries. Whether it is the peculiar sensation produced by the wriggling of these maggots that is mistaken for some superior quality of this fruit I know not, but the fact remains that the best and alas the fairest also of our citizens will resort to any subterfuge to pass a mango over the quarantine lines. The mango is a grave danger. There is always the possibility that some curious minded person will take one inland to a country home, then, despite all our care and watchfulness, the trick will be turned. I am of

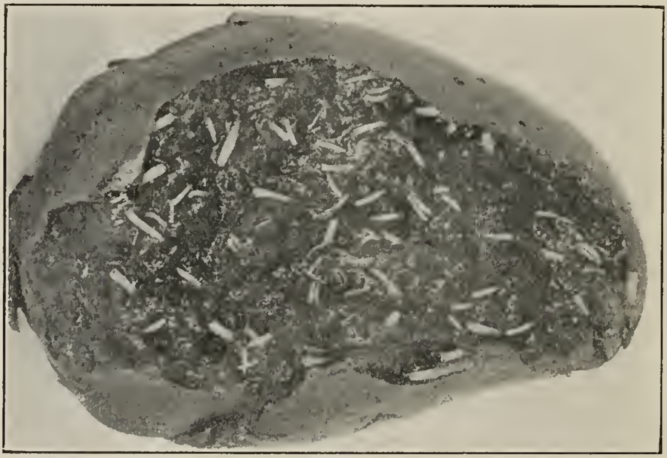

Fig. 323.—Mango infested with maggots of the Mediterranean fruit fly, *Ceratitis capitata*. (Photo by Chatterley. M. B. Cal. Hort. Com.)

the opinion that it would be a good investment for the fruit growers of California to raise a fund, buy all the mango trees in Honolulu, have them grubbed up and burned, and a way devised to prevent any more being planted.

California.

This is an allegorical picture, but it is based on facts. You are going to hear a lot of things said about quarantine work and quarantine orders before the convention adjourns, so take a good look at it and draw your own conclusions.

And now, ladies and gentlemen, thanking you for your attention, and assuring you that your quarantine officers at every one of the stations are doing their duty and living up to all the traditions of the service, I wish you good night.

SECOND DAY—MORNING SESSION.

Fresno, California, December 12, 1912.

After an invocation by Rev. Duncan Wallace, the meeting was called to order by G. Harold Powell, who acted as chairman.

Chairman Powell. I appear somewhat handicapped coming in here just at the last minute, without knowing very much about what was done at your convention yesterday. I understand the chief object of getting different people outside of the Commissioner of Horticulture to preside is that in this way these same people will be less troublesome when they are in the chair than if they are in the audience. So I take it that the Commissioner has taken this very nice way of relieving this convention of a troublesome character, by canning him and putting him in the chair. I understood from a short talk with some of the men who were here yesterday, and with some of the ladies, too, that this is a decidedly progressive convention, that everything was all right, the nursery stock all free from bugs, and that everything was going ahead. That is right, just as it should be. Conventions of this kind cannot go forward and backward at the same time.

Your programme, as I see it, has for this morning several very good numbers on it, and the first speaker on the programme needs no introduction, but I take pleasure in introducing you to Dr. A. J. Cook, State Commissioner of Horticulture, who will address you on the subject of cultivation and subsoils.

SOILS AND SUBSOILS.

By A. J. Cook, Sacramento, Cal.

When President Garfield was shot the first news was "probably fatal," then there came the glad message, "recovery probable; temperate life and abstinence from drink and tobacco greatly in his favor." Similar words rejoiced us all when Roosevelt was so cruelly wounded last October. The robust, vigorous animal will survive disease, exposure and wounds when the one with a more feeble body topples over.

Our cousins, the various plants, are subject to the same law. Fungous and bacterial germs find ready victims in the ill-nourished trees or the enfeebled shrubs; thus blight, wither tip or fungoid and bacterial germs are quick to lay hold of the shrub or tree that from over-fruiting, cemented, impoverished, ill-drained or water-logged soil is weakened or diseased. There can be no question but that the surest way to resist fungoid attacks is to only grow vigorous and robust plants and trees.

There are a number of plant affections that seem to be wholly due to physiological disturbance—the plant is sick; thus the common "die-back" of citrus, walnut and most deciduous fruit trees is probably the result of faulty soil conditions and illy-nourished trees. Pallor in the man might be called "dieback," for here the skin is surely in a sense dead or weakened; that malnutrition would first manifest itself far away from the source of supplies in wilt or death is just what we should expect. Thus such terms as "wither tip" and "dieback" are not only significant in locating affection, but they indicate peripheral disturbances in the most susceptible location.

Chlorosis, yellow leaf or variegated leaf is precisely like pallor in the human subject. Here through malnutrition chlorophyl is not sufficiently provided, and the plant yellows. If asked why the chlorosis, we can only reply: "The plant is sick." To name the cause, we cannot; we must know the entire condition of the soil as to mineral and moisture content and physical texture as well to diagnose the ailment correctly. The same can be said of "gummosis," scaly-bark, "mal di gomma" and possibly brown spot of the orange.

We see then that to know the needs and exact condition of our soils and subsoils is of supreme importance to every tiller of the soil; the health and fruitfulness of his trees are wholly dependent on the composition, texture and general physical condition of the soil of his orchard, and no study or research from himself or experts whom he may secure to aid him can pay better than a thorough investigation of his soils.

How to Investigate.

Before one purchases land for orchard purpose he should know accurately the conditions of not only the surface soil, but also the subsoil. If he already possesses an orchard and is not informed of the exact character of both soil and subsoil, he cannot too quickly acquire this knowledge. There are two kinds of data that are very essential: Character of the soil as to texture and mechanical make-up and composition. There are two ways to determine the first; by digging trenches in several places in the orchard, from a point immediately beneath the tree to the center between four trees. This ditch should be five feet deep and of convenient width to work easily. This shows the mechanical condition, the moisture content and root distribution. Such trenches are often a great surprise to the owner of the orchard and will often entirely modify his practice. A second way is to use the King soil tester, which costs about $7.00, and should be possessed and regarded as invaluable by every orchardist. This enables one to secure a cylinder of soil an inch in diameter quickly and easily in many portions of the orchard down to a depth of six feet. Except for root distribution this gives all the data that are secured from the ditch and at very slight expense and labor. For soil analysis I believe we are now dependent on private aid, which we engage and for which we pay. Doctor Hopkins, in his address at Santa Barbara, emphasized the value and importance of such analyses, and suggested that the state ought to provide for such service, but that each orchardist should pay for the same. This would insure a reliable report and would give the amount of humus, nitrogen, lime and available potash and phosphoric acid.

Soil Ailments.

Of course, every soil is likely to be destitute of the required amounts of these necessary soil elements: humus, nitrogen, lime, potash and phosphoric acid. Any deficiency of these can be supplied most cheaply by the use of cover crops; also by the use of stable fertilizer when that can be had at a price that is not prohibitive. By such practice we also secure the invaluable humus. There is no question but that our California soils are lacking in humus or decaying organic matter. The cover crop supplies the need, and if a legume like vetch, Canadian field peas or bur clover, furnishes nitrogen as well.

Mr. Powell of New York, so famous as a producer of apples, contends that he owes much of his success to the use of cover crops. Moreover, he has by their use made many of his trees annual bearers.

In the absence of stable manure we may use alfalfa, as suggested by both Doctors Hilgard and Hopkins. Doctor Hilgard asserts that alfalfa is worth $8.00 a ton simply to plough under as a fertilizer; Doctor Hopkins suggested that it might pay well to grow alfalfa in fields adjacent to the orchard to be used exclusively in fertilizing the soil.

We may also secure the separates directly from the dealers in commercial fertilizers, and apply them as needed, or we may purchase a complete fertilizer; the former practice is probably the better, if one is willing to study into the matter thoroughly. For nitrogen, nitrate of soda or Chili saltpeter is often used. Its ready solubility and quick action makes it desirable in early spring before the ground warms up and growth is active. The late Doctor King urged caution in its use, as it may add to the amount of carbonate of soda or black alkali in the soil and so do serious harm. This results from a chemical change in the soil. The use of gypsum would lessen the danger. The ready solubility of this salt makes its escape in the run-off probable, if not used very cautiously. Many prefer tankage or dried blood. This organic nitrogen is without objection; it is all utilized.

Limestone is becoming more and more recommended as a fertilizer. It should be ground lime rock, not burnt lime. It is quite soluable and so need not be very finely ground.

For potash we may use potassium sulphate or potassium carbonate, the chemical term for ashes. Though these are quite soluble, they are retained in the soil, and, like the phosphates, are not usually lost by drainage. They should be applied deep in the soil, where they are needed and utilized.

For the phosphates we may use finely ground bone or rock; either is excellent. If we wish to make these immediately available, we may treat them with sulphuric acid, reducing them to superphosates, which are more soluble. If, however, there is abundant humus in the soil the untreated bone or rock, if very finely ground, and the bone steamed, will be available and no whit lost. Phosphate slag is also available as a source of the needed phosphates.

Cemented Soils.

Hardpan—natural or induced—is all too common, and there is no greater bar to success in the orchard. The natural hardpan can be broken up by blasting with dynamite. The developed hardpan is caused by lime in the irrigating water and is often called "plow-sole," as it occurs just beneath the plane of cultivation. A more suitable name is "irrigating hardpan," as it is usually caused by the lime cement in the water used in irrigation. The water, as it comes from the rocks, is saturated with bicarbonate of lime. This is very soluble, but as it enters the soil it becomes reduced to carbonate of lime as the water evaporates, and the less soluble carbonate cements the soil into the so-called plow-sole or irrigating hardpan, which, of course, must form just where the greatest evaporation occurs or just at the level of the cultivation limit. In dry seasons and late in the season this cement is most in evidence. In seasons of heavy winter rains this cement or hardpan may entirely disappear.

This artificial hardpan is entirely too common. It is the cause of much of the chlorosis and ill health of the trees. It may be that dieback often owes its presence in our orchards to this cementing of the soil. That it would foster gummosis and other bacterial and fungoid attacks is more than probable. Early deep cultivation and cultivating at varying depths through the season will aid to break up and prevent this impervious formation. It is quite common now among many of our best orchardists to use the subsoiler during the season to break through this cemented stratum of soil. Early deep cultivation will often prevent its formation.

Alkali.

There are two soil salts that are known as alkali—carbonate and sulphate of soda. The first is black alkali; the other, white alkali. Both are quite readily soluble and present in small quantities in most all rocks and so are conveyed in very minute quantities in most all running water which flows from the rock strata of the earth.

In low, poorly drained sections—usually clay basins—these salts are often present and harmful. Black alkali is much the more serious. It takes its name from the fact that earth containing it in the presence of humus is very black in color. Sowing gypsum on such land tends to change the black to the much less injurious white alkali. Thorough drainage and plenty of water will wash out the alkaline salts and restore the fertility of the land.

This explains why arid soils are much more likely to be alkaline than are those in humid regions. It remains to be said that some crops are far more tolerant of black alkali than are others.

In purchasing land every one should examine closely to find whether alkali and hardpan are present. If either occur in very limited areas this would be no bar to making the purchase; if in considerable abundance, one better think twice before procuring such land for ranch purposes.

Water Content of the Soil.

A water-clogged soil is very prejudicial to plant growth. A great scarcity will also cause the crops to die of thirst. This latter is very serious in times of extreme heat. Drainage is the cure of overwet soils. They prevail in clay basins and are especially serious where the subsoil is cemented as already described.

A soil may be parched from neglect when from parsimony or scarcity of water the irrigation is omitted. The irrigating hardpan or plow-sole often keeps the water from the roots of the plants and trees, and brings on wilt and death.

The King soil tester and the ditch already recommended will often reveal a condition of moisture and root distribution that will surprise the orchardist, and suggest a quick modification of his orchard practice.

Aeration.

We now know that every live soil is the home of countless millions of micro-organisms. These change the ammonia to nitrites and these in turn to nitrates which can be absorbed and utilized by the plants. These minute bacterial germs transform the humus into the necessary food to form tissue. Another group of these bacilli have the power to co-operate with leguminous plants in changing the inert nitrogen of the air into nitrates so costly and necessary to all plant nutrition. These and other valuable soil micro-organisms must have oxygen to live—thus the necessity of soil aeration.

One of the most important functions of cultivation is to provide this aeration. Every soil at all times should be loose and friable. Clay soils often suffer from neglect of this aeration because of the lack of thorough cultivation. The highest success in fruit growing demands thorough aeration, and this only comes especially in clay soils with the most thorough stirring of the soil.

Dry Earth Mulch.

We have referred above to the necessity of soil moisture. It is the most important plant food and is all too scarce in many of our orchards. Its conservation is all important. Humus helps greatly to hold it in the soil. It does this in acting as a sponge in clay soils and compacts sand to its betterment.

One of the best uses of cultivation is to form a dry earth mulch, a very loose stratum at the top of the soil from four to six inches in depth. This must never be neglected would we reach the best in our tillage. This demands thorough cultivation after each rain or irrigation throughout the growing season of the year. Few of us secure this perfect dry earth mulch at all times when plant life is most active. The best ranchers are keenly alive to its value and necessity, and their great crops and profits speak eloquently in its praise.

Summary.

To sum up, healthy plants exist only in a rich loam soil. The ditch and soil tester give the necessary knowledge. Soil texture and composition must be right. Cover crops, stable fertilizer and commercial fertilizers are very important. Humus, potash, nitrogen, lime, and phosphoric acid must abound. Hardpan is a serious obstacle; alkali is also inimical to success. Right water content is a *sine qua non* to great productivity. Aeration is a prime factor in successful ranching. To neglect the dry earth mulch is to court failure.

Chairman Powell. This subject will now be open for discussion. This is a very interesting subject—one of the most interesting that could come before any convention of agricultural producers in California. There is less known about the soils and what can be done with the soils in our irrigated countries than with any other thing that the farmer or producer has to deal with. In our country, in the south, we can go out among any of our best fruit growers and ask them what particular fertilizer they use, and we get a hundred different replies. Ask them what the best method of distributing water is, the depth of irrigation and how much it varies, and the amount of application, and you are likely to get a hundred different points of view. Or if you ask them about the use of cover crops, or almost any other one factor connected with the production of the crop, you will get as many points of view as you will get men to express them, and yet a large proportion of these men using different methods may be equally successful, and so this subject of soil and cultivation is one of infinite controversy, because many of the fundamental principles connected with soil handling and soil management are still only in the infancy of existence. We have in the south a great many soil difficulties. My experience when in the citrus work always seems to be difficulties in the handling and management of the soils. That is physiological troubles of fruit trees, due to the improper handling of fertilizers or cultivation or irrigation or hardpan or various other things which tip over the neutral balance of the plant itself. So this question of soil handling and soil management is as varied as any that will be met with or that will come before any body of producers anywhere in California, and so this subject will be open now for discussion, and I hope a number of you will take part. I shall call upon Mr. Chapman to open this discussion.

Mr. Chapman: Mr. Chairman and gentlemen: This is a splendid paper, to be part of a book which we need in California. It is a book we need, especially our citrus fruit growers need a manual of this kind. I am approached almost every day with newcomers wanting a treatise, wanting some instructions about citrus fruit culture, and we have none. So I want to thank you, doctor, for making this contribution to this great industry and I know it will meet with a large sale.

Dr. Cook. It is to be a gift to the State, it won't be for sale.

Mr. Chapman. But the soil is the great factor of this country, the greatest in the world. Now, if we had a factory in California that turned out nine billion dollars' worth of product in a year, we would, of course, take a great interest in doing that which would multiply the efficiency of that plant, and if we could make that plant produce twenty billions of dollars a year instead of nine we would have accomplished a great result. Now that is the point. For when any soil is properly treated, properly handled, it can be made to produce two or three times as much as it does to-day. This Lever bill, which is before the Senate, is said to be the greatest act presented to Congress since the day of Abraham Lincoln. Many of you know about it and perhaps some do not. This refers, doctor, to the efficiency of our soil, and this bill your Committee on Resolutions is going to ask you to vote a resolution to be sent to our Senators asking them to urge its passage and do what they can to secure its passage. If I may, I will just depart a little from your paper and will, doctor, if you will permit me: this is right on your line. Here are some remarks expressed by this League:

> "There is no occupation in the world that calls for more ability and judgment, brains, training, industry and adaptability than farming. It is a man's job. To plow and sow and reap without understanding is no more real farming than cutting a man's leg off with an ax is real surgery.
>
> Agriculture is the basis of the nation's wealth. The soil is our greatest asset, and conserving and building this up helps every one.
>
> ### Facts and Figures Illuminating and Alarming.
>
> In ten years, between 1900 and 1910, our population increased fifteen million—about 21 per cent; our farm area increased a little over twenty millions in number.
>
> In 1900 for every one hundred people we had 90.3 cattle. Ten years later we had only 68. For hogs the figures were respectively 84, going down to 61; for sheep the drop per hundred population was from 82 to 51. *Think what this means!* Cheap meat cannot be made on high-priced land and sixty-cent corn, but *science, the silo and alfalfa will enable the farmer to carry three times as much stock on his farm as he thinks he can.* This would build up the fertility of his fields and reduce the cost of producing meat one half.
>
> We now consume 98 per cent of our corn and 91 per cent of our wheat. We have an unprecedented high cost of living. We must produce more, *and we must get it to the consumer at less cost.*
>
> There are approximately ten acres of farm land per capita for the present population. Only one half of this is under plow; the other half is woodland, waste land, broken land, pasture, etc. It now takes practically all we raise to feed the people. We are beginning to import foodstuffs. *In fifty years our population will be doubled. What shall we do about it?*
>
> A generation or two ago Denmark was in poverty and distress.

> The government wisely determined to revive agriculture and apply scientific methods. It tried various means to that end, but with little success. It finally sent out the trained farm demonstrator (just as provided in the Lever bill). This did the business and brought Denmark from poverty to thrift. It doubled the land values; it quadrupled the savings banks deposits; it made Denmark a happy, prosperous nation. It sent the people from the cities back to the farm, and Denmark to-day is the finest agricultural country in the world."

Dr. Hopkins, a gentleman we all know, demonstrated in southern Illinois by the use of one dollar and a half's worth of phosphates. He uses the word "phosphates," we use the word "superphosphates"—means about the same thing. He spent one dollar and a half per acre and raised a production of corn from sixteen to twenty bushels to the acre to fifty bushels to the acre, at an expense of a dollar and a half per acre. Think of that. Well, now, I want you to take an interest in this Lever bill. It is worthy of our consideration and some of the best men in the country are back of it—business men as well as farmers. Because it is worthy of consideration, when it gives you fifty bushels instead of sixteen, then they will have some business. There are still some of these men, however, who are deeply interested in having their country grow instead of becoming rich solely for their own pocketbooks.

Now as the doctor's paper was very plain, I can simply modify a few points that he made. I was surprised myself when I got one of these soil testers and I think all should have one. It is a time saver. I can go out in my orchard and find results which I did not know existed and I expect most of you would also be surprised, because you can only imagine that your piece of land is the best piece of land in all that locality. Every fellow has the best farm, you know. Well, this soil tester is a wonderful thing; your ground may look well on the surface, but go down, dig down a little here and there and you will be surprised, and the result is, of course, it informs you of the real condition of your soil and therefore you know how to treat it. That is the idea. Now, of course, we wish we might have this state analysis of soil, because we have got absolutely to put our farming down upon a more scientific basis. We have got to know better what we are doing. We are spending a lot of money, and we have got to know whether we are doing the right thing. Get results. I might get better if I only knew how, but I don't know, and so I do the best I can.

About the alfalfa proposition, doctor, I think you would have trouble down in our country any way in getting men to grow alfalfa and putting it in the ground, plowing it under as a cover crop and letting it stay there, when you can put it on the market and get sixteen and eighteen dollars a ton. Too much money in sight to convert alfalfa into fertilizer for the orchards, and of course I don't grow it in my orchard. Another thing, growing it in an orchard, it makes fine feed for the gophers. Don't think it a good idea. Now, of course, in some localities lime is found, and perhaps many of you live near beet factories and you can get lime from any of these at small expense, which you can put on your soils and get the same results, doctor, as you can get from more expensive application. And about the phosphate slags that the doctor speaks about; I have used that I think with some success, but I don't think it is on the market anywhere. Some firms handled it for years, but last year they said they didn't have it, wouldn't any more, so I don't think you can get that.

The question of spraying for red spider was up yesterday and the doctor seems to think that you should spray anyhow. I do not think that is a good idea, doctor, just simply to take some medicine for fear you are going to be sick. I have just buried a dear old friend of mine. He died simply on that account more than anything else. Took medicine all the time for fear he was going to have some trouble and naturally just killed himself. Now a year ago I had some red spider in my orchards, one of them, and we got our horticultural commissioner to come, and we got after them and we got them. We eradicated them from a little patch of about ten acres. Now I haven't them, not enough to amount to anything. Furthermore, you would find some red spider in any orchard, but I would not be justified in going out every year and spray four hundred acres for fear the red spider might come in some of these orchards, and so you have got to be practical as well as scientific and theoretical, so I do not think I will go away, doctor, and go home and spray. But as to the question of irrigation; many of us think we are irrigating when we are not. This hardpan keeps the moisture to the surface. When I go into another orchard and see a fellow irrigating and the whole surface is moist, is wet, I know what the matter is there. All the water is staying on the surface and not going down; I would like to see the surface dry, because this hardpan which you can easily develop in our California soils, at least in southern California—I do not presume anything like that is to be found here where you have fine land and land projects are going on, you people do not have anything of that kind, but we do in southern California. I understood yesterday from the glowing accounts of all northern California that you didn't have anything but what was just right—no scale or hardpan or anything else, but that it is a glorious place for the entire country to come to, but we do have these problems, and I know you have to contend with them, too; but this is a point, Mr. Chairman, that all of these questions and these conventions are a great factor in creating a sentiment that will make us investigate and make us intelligent.

Just a word here now in closing, and I have always said this. I think you must have quoted from me because I have always thought it. There is no occupation in the world that calls for more ability, judgment, brains, training, industry and adaptability than farming. This is an immense job. To plow and sow and reap without understanding is no more real farming than cutting a man's leg off with an ax is real surgery. I contend that it requires the greatest ingenuity to be a farmer. In fact, it requires a larger range of intelligence, general knowledge, than to follow any other occupation or profession that I know of. There was a farmer once, a neighbor of mine, a German neighbor. He came over to my place one morning and wanted some of us to go over to his place and fix up a gas engine that wouldn't work. He says to me, "I tell you vat, Mr. Chapman, a farmer has got to be a better mechanic than a mechanic is himself." So it is with the farmer.

Chairman Powell. I was at a meeting the other night where there were a lot of politicians, and one of them got up and described the method of how the woman's suffrage bill was introduced into the legislature, and some one else started in, and before he got through every man in the audience claimed priority in introducing woman's suffrage. We have a few minutes more left for discussion—any one else?

Mr. Chase. I would like a little information. Mr. Chapman has made a little mistake in regard to the alfalfa, which is a problem of very great import with us. It has been proposed to grow alfalfa between the rows of trees. A large wealthy corporation up here has some of his trees planted and wanted to grow alfalfa between the trees as a fertilizer. Now that place of his is a wonderful success—I know. He planted the alfalfa between the trees and then plowed it in. Here is hardpan soil, not this plow-sole in which water soaks in quickly, but this wet hardpan which is formed by the rains and comes from feldspar or granite formation. We have that from two to three inches to a foot thick, three or four feet under the soils. We plant our orange trees by dynamiting at least four feet deep and in a circle about ten feet in diameter. Seven of these trees were planted twenty-four feet apart; here is your orange tree two feet below the hardpan. Now you plant alfalfa between those trees and irrigate the alfalfa, which requires four or five times as much water as the orange tree itself. Will not that irrigation keep the roots of the orange trees so saturated that you need not have to worry about irrigation? Now there is the case of Mr. H., one of the best growers in the state, who is growing alfalfa, and has been for five years, between almond trees, and I was notified to go and see what was the matter with his trees, whether fungi was killing them or what. So I went and made an examination and found that a parasitic fungus was attacking them, but it acts to me like over-irrigation on the alfalfa on these trees, but still the point is not fully settled. Now it is hard for us to know whether we can grow alfalfa, whether it is best for fertilizer, for cover crops, and if we can grow it between our trees where soil has to be dynamited every four or five feet.

Mr. Chapman. I think it will grow; don't doubt but that it will.

Mr. Chase. Without injuring the trees?

Mr. Chapman. Well, I wouldn't put it in.

Mr. Chase. Now there was a proposition of a hundred and sixty acres of oranges, and I was asked about alfalfa for fertilizer, and I didn't know. They plowed it in two years until all of the alfalfa was in and used it as a fertilizer. Whether that could be done in our section I don't know.

Mr. Chapman. Don't believe he could do it with a second hundred and sixty acres.

Chairman Powell. We are all vitally interested in this soil discussion. You may not all be interested in the citrus industry but I am sure you are all interested in what means so much to California, as the handling of the soils. I venture that the discussion of Mr. Chapman's has been worth a great deal; I suppose he has spent at least two hundred dollars an acre, if not more, exclusive of picking the fruit, on his orchards. I venture to say that a large proportion of the growers of California know absolutely nothing, are without knowledge of why they are doing certain things, but it seems to me all should realize the importance of their soils. We are entirely in the dark over the fundamental principles of soil cultivation and so we should be interested in any active citrus industry that has to do with land handling or land management because we are expending an enormous amount of money in the production of fruit and we know we have only just begun to understand the fundamental principles of the handling of the soils. Any more questions?

Mr. Aaronsohn. I would like to ask the speaker here regarding cover crops, if you use lupine in your orchards as cover crops. Do you use them with any great success?

Mr. Chapman. Lupine is not used to any great extent in California. Vetch is most often used as a cover crop. Clover and bur clover wherever it can be brought in is also used.

Mr. Aaronsohn. Is there a reason why you cannot use lupine?

Mr. Chapman. I am not posted on this; can any one answer that question?

Dr. Cook. It has been found that vetch did better. In southern California about ten or twelve years ago lupine was used, but it would not work satisfactorily, and vetch was found to be so much better.

Chairman Powell. Mr. Chapman has well said that the progress of the agricultural industries of this country must be based upon scientific knowledge. We have with us this morning the Dean of the College of Agriculture of Berkeley. I have known Dr. Hunt for a number of years in his work in the east. I do not know whether his work has been outlined to you here, but Dr. Hunt came first from Illinois and was then Dean of the College of Agriculture in Ohio and from Ohio went to Cornell University as the head of the Department of Agronomy, and then went to the state of Pennsylvania. Dr. Hunt is experienced in the handling of agricultural matters and is broad in his views; is experienced in matters in organizations of research work, educational work and university work, and these have marked him as one of the leaders in the development of horticultural and agricultural matters in America, and I think California is to be congratulated that in the new reorganization of the College of Agriculture that it has been able to secure the services of a man who has already left his mark among the most progressive leaders of the new agricultural science and education of America. I take pleasure in introducing to you Dr. Thomas F. Hunt, who will address you on the subject: The Motive of the College of Agriculture of the University of California.

THE MOTIVE OF THE COLLEGE OF AGRICULTURE OF THE UNIVERSITY OF CALIFORNIA.

By THOMAS F. HUNT, Berkeley, Cal.

The men and women connected with the College of Agriculture and Experiment Station have for their aim the development of the agricultural resources of California. The word *agriculture* is here used in its broadest significance, namely, the economic production of living things. The agency through which this body of men and women is to accomplish its purpose is the University of California, but I wish here and now publicly to announce that they are eager to co-operate with all other agencies—federal, state or private—which may have for their main purpose the maintenance in California of a successful family life.

The assertion of Dr. Carver is fully accepted, that if one admits that life is worth living, he who allows the love of money, or power, or land, or science, or literature to interfere with the rearing of a noble family commits a criminal act. It is not necessary that every one should assume the marriage relation, but when a couple has taken each other for better or worse, it is a crime to permit any other motive or ambition to prevent the rearing of a worthy family. A man's business should be his means of making a successful home and not the means of getting a front page illustration. Between the age of twenty-five and fifty the wife may well assist in this enterprise.

I was permitted recently to sit at the table of a capable woman. She exclaimed, "I am a free woman. I am fifty. I no longer need to conceal my age." According to the law of probabilities this woman has twenty years to devote through education and politics to promoting the social welfare. The women of her class have the power to become through their mature judgment and culture the greatest and most benign influence in every community.

It is so plain that he who runs may read that not only can no development of agriculture be considered wise which does not lead to a successful family life, but that in California a proper development of its agriculture is essential to this end. The acceptance of this doctrine by the Anglo-Saxon race would solve many if not most of the difficulties which beset the body politic. It is the home loving people who inherit the earth. It is the immediate duty of the College of Agriculture through research and education to make the agriculture of California more prosperous. Through its various divisions, it is straining every nerve to solve the material problems which beset those who create wealth from the soil. It is its chief duty, however, to develop those methods of agriculture which are of greatest benefit to society. The College of Agriculture is not primarily interested in whether the profits of agriculture enable the ranchman to substitute for his $3,000 automobile a $5,000 motor car, but it conceives its chief concern to be a prosperity that leads to the proper economic, social, moral and spiritual ideals in the community.

When the interests of the individual and those of society become opposing forces, then here as elsewhere in the history of the human race, individual interests must be sacrificed for the benefit of the common good. Lest I be misunderstood, permit me to moralize for a moment. While the trait which we honor most in any individual, the trait which has made all truly great heroes, is sacrifice, it does not follow that there is no virtue without sacrifice. In the new conception of a successful life, we do not have prosperity without morality, but we have prosperity because of morality. Efficiency and morality may not be synonomous terms but they are mighty good chums.

This, then, shall be the keynote of the College of Agriculture. Those who shape its destinies will never forget that it was formed and continues to exist to promote the material welfare but they will always recognize that this material welfare is for the sake of a successful human existence and that primarily this is based upon human efficiency. Five thousand years ago, the natural resources of these hills and valleys were, so far as we know, as great as they are today. The Aladdin-like development that has occurred from Imperial to Shasta during fifty years is due to a hardy and efficient race of people. This race must be perpetuated. Once more I wish to repeat that the faculty of the College of Agriculture invites the co-operation, support and guidance of all agencies which believe in this program.

If now we take a hasty glance into the future we cannot fail to be impressed by the fact that the two great problems before California are to stabilize its water supply and humanize its labor supply. A few simple concrete illustrations may be better than much abstract discussion. In the Salt River Valley, Arizona, approximately ten million dollars have been expended, including the great Roosevelt dam, to stabilize the water supply over 130,000 acres of already irrigated country and to bring 100,000 acres of the desert under the irrigation ditch. It was expected that this greatest reclamation enterprise in the United States would furnish about two dollars worth of water per acre. In other words, a gross income per annum of about one half a million dollars was anticipated. Although the enterprise has scarcely been completed in all its details, already it has contracts for one million dollars' worth of electric energy. It is said that there is nowhere any more livable region than in the foothills of the California mountains. Here can be developed unlimited power without the loss of any natural resource except the oil required to lubricate the machinery. In developing the power, the water in the valleys will be mobilized. When this is accomplished, California will have ten millions of people in place of two and a half millions. The slogan for California should not be one million persons for this or that city, depending upon which part of the State one is from, but two million families for California. Cover your hills and fill up your valleys with homes and the cities will take care of themselves.

A certain rich man who made himself wealthy by mixing a well-known California product with a commodity not unknown to any state and selling it as a cure for various ills, purchased a considerable tract of land in a state famous for the presidents which it has produced and began breeding Percheron horses. This man had the money to buy the best horses of the breed. He was capable of employing the most expert superintendents. The soil and climate were sufficiently like that of "La Perche" to satisfy the requirements of horse breeding. One day I chanced to meet a groomsman who declared that the enterprise was doomed to failure. "Why?" he was asked. "Because the Percheron horse is the result of loving care by generations of farmers. Mr. Blank, with all his millions, cannot purchase these generations of men without whom these horses are not possible." Our rich friend still operates his land, but he has long since ceased to try to breed horses.

California has rich river valleys whose conditions are like those which generations of Holland farmers have made famous. Canada has its agents in the lowlands inducing the Holland farmers to migrate to this northern country, while our river valleys with their mild climate remain undeveloped. To develop this State with the least human sacrifice some selective process of locating people upon the land is needed. It is said that the farmers in the countries bordering upon the Mediterranean Sea are now saving their money against the time of the opening of the Panama Canal. When the thrifty Mediterranean folk come to our shore it will be the first time in the history of the world that these races have migrated to a country which was similar in its possibilities to their own. To entice these people upon land by means of "decoys" would be a social and economic crime. We need to study the history and adaptation of the peoples who now live in regions with natural conditions similar to our own. Instead of alluring the off-scourings we should by some selective process secure the intelligent, thrifty, moral countryman whose generations of experience will help to develop this country. When he arrives he should be located among natural conditions with which he has been familiar and protected until he has his industry upon its feet. It would be a form of protection that would protect. If you wish to compete with the peoples of the world you must develop in every locality that industry which naturally does best in that particular region, and you must put it in the hands of people who are the most expert in that particular industry. By no other process can a state be developed to its highest efficiency.

The president and board of regents will be asked to establish a department in the College of Agriculture, to be known as the Department of New Agricultural Industries. Already the United States Department of Agriculture and the State Experiment Stations have done splendid work in plant introduction. The introduction of a plant and the establishment of an industry upon that plant however are two widely different things. This department of New Agricultural Industries will not be a research nor a teaching department in the ordinary sense of the term. Its duty will be to study the agricultural industries of regions having conditions similar to California and to study our own State with reference to any industries which investigation may seem desirable to transplant. Last week we were told that Palestine is an exact counterpart of California, except that Palestine is only one tenth the size. Within this diminutive area, it duplicates the Sacramento and San Joaquin valleys, the valleys of the coast and the Sierra Nevada and Coast ranges. There is the same variation in climatic conditions, and above all they have a four thousand year old agriculture. No one knows what agricultural lessons this old world holds in store for us. Perhaps it may yet enable us to become the greater Palestine of a new civilization.

We have been discussing a century long program and a state-wide movement. Every man and woman in this audience will have been gathered in by Father Time long before our water supply has been fully stabilized and our labor supply fully humanized. We are not now dealing with the individual, but with society. If society is not able to look beyond the confines of its individual members it is doomed to eternal damnation.

It may have occurred to some of you that the questions which have been discussed are beyond the realm of the institution which I for the moment represent. What has been said is for the purpose of emphasizing the fact that the University of California is perforce the leader of thought in all that relates to the welfare of the State, and its College of Agriculture, if it is to be effective, must be the leader in all that relates to the development of agriculture. To fail to accept such leadership would be to fail to understand the responsibility that is placed upon it. Any other attitude upon the part of the people, whose child the institution is, would be reprehensible.

Pedagogically speaking—I use that phrase because I do not know what it means—the College of Agriculture has two ambitions: one is to become the post-graduate institution in agriculture for the western third of the United States, and the other is to supply the demand in California for teachers of agriculture in the secondary schools. To receive the agricultural graduates of the western third of the United States and train them for greater service in the institutions from which they came, is not only a privilege but a responsibility and one which every other institution will welcome. If this institution assists in the preparation of the future instructors and investigators of our western colleges and prepares the teachers of agriculture for the high schools of California, it will be performing a service of untold value. The two ambitions to which reference has just been made are, of course, after all only a minor. What of the educational work of the College of Agriculture?

In developing our undergraduate departments, at least some of them will be organized around the industries. Already we have the Department of Dairy Industry, Animal Industry, Agronomy or field culture, Citriculture, Viticulture, Pomology or deciduous tree fruits, Floriculture and landscape gardening. The reasons for this are many and complex, but one important reason is that we are not teaching subjects but students. The student is going to become a lawyer, or a citrus grower, or a doctor or a stock raiser, or a teacher or a dairyman. Harvard was founded to train ministers and afterwards because ministers gave so-called medical advice, it began to train physicians. Later, lawyers were brought in out of the rain.

The land grant colleges were founded to train young men and women in the several pursuits and professions of life, of which housekeeping is one—in some localities. The difficulty with agricultural teachers has been that they have been absorbed in the pursuit of knowledge and obsessed with the importance of their discoveries. Greek must be made a good training subject or it cannot justify its existence in the University curriculum. Agriculture can be made just as good a training subject if we remember we are dealing with young men who have red blood in their veins and who have an ambition to live a life of usefulness and power. If we forget it, they had better study Greek.

The successful teacher of agricultural subjects must not only be concerned with his subject and with his students, but if he is also an investigator, as every good teacher should be, he must concern himself with the people in the industry which he teaches. There is no state in the Union where it is so necessary for the agricultural professor to know thoroughly his subject before he undertakes to deal with the men who make their living from agriculture as here. In California they do not hunt grizzlies with shotguns.

The College of Agriculture is not merely a teaching institution. It has three phases: research, education, and public service. When it comes to organizing its research work, especially where large questions and interests are involved, we shall organize around the problem rather than around the industry. These strictly research departments will not be charged with undergraduate teaching but will be permitted to take post-graduate students. A real post-graduate student is one who is working out some problem. Thus there has been organized a research department with headquarters at Riverside. There has been called to preside over this department, Dr. H. J. Webber, Professor of Plant Breeding of Cornell University, who is one of the best known teachers of post-graduate students in this country.

In the location of its headquarters the College of Agriculture is somewhat unique among institutions of its kind. Its location has been looked upon as an element of weakness. As the institution develops, I think it will be found to be, on the contrary, an element of great strength. It puts us face to face with the problem of how to give to the student of agriculture the training and experience which they must have in order to succeed in any one of several agricultural pursuits. The plan is to bring the student to the close of his sophomore year with as thorough a training in English, mathematics, language, history and science, as his years of schooling will permit. In addition to these studies, each student before reaching the junior year is to receive instruction in the following four agricultural subjects:

Agricultural Chemistry.
Soils.
Plant Propagation.
The Principles of Breeding Plants and Animals.

The last, I consider almost as fundamental as the English language. It is believed that the work of these four subjects should be required of every student, whatever agricultural profession or pursuit he may subsequently follow. Since they are to be required of all students of agriculture and since they are the first technical ones in the student's course, great care will be taken to secure for these four subjects inspiring teachers. The student who does not come early in his course in contact with, at least, one teacher that inspires him with the love of scholarship and subject, misses the best part of a college education. After instructors have been called they will not be permitted to place these sophomore subjects in the hands of assistants, while they confine their teaching to upper classmen.

Having brought the student to the close of his sophomore year, when he must decide in what agricultural profession or pursuit he will specialize, the question arises how, with our present headquarters, we can offer him suitable training. During the past decade forestry schools have been compelled to study this problem. It is possible to locate an institution on a farm, but there are some difficulties in locating it permanently in a forest. The approved plan in forestry schools now is to take the students at the close of the sophomore year to the forest camp where for eight weeks they are given both theoretical and practical instruction. During the junior and the first half of the senior years they pursue their studies at the college. The last half of their senior year they are again taken to the forest, where they receive instruction under conditions which experience has shown are essential to the preparation of seasoned foresters. When the forestry courses were first established, the students went to the forest camp at the close of the junior year.

There are three reasons for changing the camping period to the close of the sophomore year: first, it serves to weed out the faint hearted. The young fellow who thought forestry was a pink-tea was promptly disillusioned and probably eliminated; second, it enables the student to appreciate better the technical subjects which he will pursue during his junior and senior years; third, it offers the student during his junior vacation an opportunity to secure employment in his chosen field, thus furnishing money with which to continue his education and valuable practical experience.

Applying this principle to our own problem, we may send sophomores who would specialize in dairying or animal husbandry to Davis; those who would specialize in agronomy, either to Davis or Fresno; and those who wish to engage in horticultural pursuits or landscape gardening, to Fresno or Riverside. When we have a department of forestry, students can go to the forestry station at Chico or at Santa Monica. Students interested in strictly subtropical fruits can be taught at the Imperial Station some of the conditions of management in these rapidly developing and truly fascinating crops. Students who specialize in soils could be taken into the soil survey work and given actual training in soil mapping. If the option is agricultural chemistry, plant pathology or entomology, the student will find the laboratories at Berkeley open to him, while students of agricultural education will find their training ground in connection with the regular summer school work of the University.

As we are now organized, students may go to Davis the last half of their senior year, where they can receive instruction in certain subjects which are developed better there than at Berkeley. This is notably true of instruction in animal husbandry and dairy industry.

While the University Farm at Davis is an exceedingly important factor in the development of the research work and is becoming a much more important factor than was anticipated in the training of University students, its most unique feature is the instruction given to University Farm School students. In this school an attempt is being made to solve the most important educational question in this country. We have in America a perfectly well understood system of education:

Primary grade	7 to 10
Grammar grade	11 to 14
High school grade	15 to 18
University grade	19 to 22
Post-graduate work	23 to 25

This is a thoroughly desirable system of education and one that should be extended to apply as nearly as possible to every young man and woman. There are, however, large numbers of young men who have reached the age of 19 who do not have the requirements for admission to college. They will not go to the high school because they are beyond high school age. They could not get the proper instruction if they did go, because the method of instruction must be different for students at 19 and those of 15 years. Age must be recognized as a factor in education. A young man or woman at 19 differs from the boy or girl of 15, physically, mentally, morally and spiritually. One hundred and twenty students entered the University Farm school at Davis this semester and 118 entered freshmen in the College of Agriculture at Berkeley. The average age of the entrants at Davis was 19 years and 4 months; the average age of the freshman entrants in agriculture, 20 years and 5 months.

An agricultural high school is not being conducted at Davis, but there is being given a three years' course in agriculture to students of university age who do not have the requirements for admission to college. In addition to the students who come to Davis because they do not have the requirements to enter college, there are high school graduates who desire to spend only two years in further study and who find the last two years at Davis upon which they can enter better suited to their needs than the first two years at Berkeley. Every effort should be made to meet the needs of this class of men. The minimum age of entrance at Davis should be raised to 18 years, first, because the student should be induced to exhaust his local agencies of education before entering the farm school; and, second, because when he has completed his three years' work he should be mature enough to enter upon business for himself.

Emphasis should be placed upon the fact that the training offered at Davis has nothing to do with the introduction of agriculture into the high schools. This should be done, but it is a wholly different thing. The high school system should be so arranged that every boy and girl between the ages of 15 and 18 can sleep at home. The boys and girls between these ages need their parents and equally important, perhaps, the parents need the children. Eighteen is the accepted age for breaking home ties. From 18 to 22 is that transitional period during which the young man or woman gets adjusted to his or her surroundings. A student enters college a boy and leaves it a man. In some ways, this is the most important fact concerning his university career. If this view is accepted, it will at once become apparent that the University Farm school at Davis is not a local institution. It may be just as useful to the young man who lives in Imperial Valley or in Butte County as to one born within five miles of Davis.

Unless the ranches of California are to be abandoned or are to be cultivated by foreigners, there are in California at this moment more than 8,000 young men between the ages of 18 and 21 who will some day occupy the land. Less than six hundred are now receiving instruction in agriculture at Berkeley and Davis. In a comparatively few years, a thousand students of agriculture will be enrolled at each place unless we do something to stop them. It should be determined at once what is the most efficient number that can be accommodated at Davis. It should be determined whether it is to be 300 or 600 or 1,000. Plans should be made to start a new unit at Fresno as soon as the most efficient number that can be cared for at Davis is reached. At Fresno, where the University owns 5,000 acres of land, there is an opportunity to build up the most extensive, most varied, and best instruction in horticulture, both for farm school and University, that is to be found in the world. No other such possibility exists anywhere. At Davis special emphasis should be placed upon dairying, animal husbandry and deciduous tree fruits. At Fresno, the emphasis should be placed upon grapes, citrus and other subtropical fruits and upon alfalfa and other forage crops. Instruction and investigations in cereals should be developed at both places. Under the conditions outlined a young man from Bakersfield or El Centro might go to Davis to receive instruction in animal husbandry and dairying, while the young man from Marysville might go to Fresno to specialize in horticultural subjects.

The tentative organization and scope of the College of Agriculture has been set forth with a good deal of tedious detail. I am frank to say that it has been done with a very definite purpose. The desire has been to make emphatic three points:

First—The College of Agriculture is located in California. Berkeley, Riverside, Whittier, Davis, Meloland, and other places are merely points of operation. Los Angeles is the headquarters of the Santa Fe Railroad, but the Santa Fe Railroad is not located in Los Angeles. Last year the College of Agriculture met face to face 150,000 citizens of California.

Second—The work which is carried on at Berkeley, Whittier, and Davis is not primarily for the development of the immediate localities, but is a part of a general scheme of education and research which looks toward promoting the general welfare of the commonwealth. The establishment of the Citrus Experiment Station is not primarily for the purpose of promoting the raising of oranges in Riverside County, but is for the purpose of studying problems which are of the greatest importance wherever agriculture exists under an irrigation ditch.

Third—Any additional points of operation which it may hereafter be deemed wise to establish must be considered from the standpoint of the general plan which has just been outlined and of the public welfare and not from the standpoint of local interest. I have faith that the people of California will rise to this high level.

The program which has been outlined is a large one. It is worthy of a great State. For its success, it needs the help of every citizen. I believe it to be both logical and feasible. I ask for it the candid criticism of every person interested in the public welfare. With the assured and earnest support which this program has of the President and Board of Regents, I have faith to believe—and I am saying this in the most impersonal and detached way—that it must succeed. I trust that President Wheeler was prophetic when he remarked several months ago, ''I believe it will appeal to the people of California. They like to do a good thing.''

CHAIRMAN POWELL. I believe that the foregoing will appeal to the people of California. There is nothing in connection with our agricultural work that has stirred the imagination of the people connected with the agricultural interests of the State more than the present comprehensive plans of the College of Agriculture of the State of California as outlined by Dr. Hunt. I was with one of our most noted citrus growers yesterday, a man who is managing property worth more than a million dollars. He is a man who has grown up on his own efforts and has had hard knocks and who had never had much opportunity when a young man, and while I was at lunch with him yesterday he said to me, the greatest drawback to him in his business was lack of imagination through lack of training, and he said what disturbed him most in connection with this great property he was managing was the fact that it was going to require more expert knowledge than he had been able to give to it in the past, so he told me he was going to send one of his boys to Berkeley, where he would be enabled to get a larger, more comprehensive grasp of the problems of management, and so can take hold of his work, do more experimental work and understand things better. Many people all through the State consider the College of Agriculture of the State of California simply as an institution. It is not an institution. It is yours, and its teachers and professors are simply servants who are operating and working in your behalf and welfare, and whether the College of Agriculture amounts to anything in the future will depend not only upon the plans which Dr. Hunt and his associates lay out, but it will depend whether you as taxpayers and citizens desire to promote and establish a large, comprehensive institution for the development of research and education and the development of our industries. It is for you, gentlemen, to say as taxpayers whether it is policy, wise business policy, to develop an institution in this State where our young men and women can be trained. I have been very much pleased with this comprehensive paper of Dr. Hunt's. I am satisfied, now that you have heard the paper, that you will agree that the introduction that I gave Dr. Hunt was not overstated. We have with us also a gentleman who is interested in the establishment of an institution, and I would like to hear just a word or two from Dr. Aaronsohn, because he has problems among the Jewish people of Palestine in this same line of work.

MR. AARONSOHN. Ladies and Gentlemen: My poor command of the English language makes it hard for me to express all the emotions which came over me when I listened to this address of Dr. Hunt's. And I feel it has been my good fortune to be able to understand clearly your enthusiasm and aims as has just been expressed. And I am glad I have had the opportunity to hear these problems of schools and colleges expressed with such a broad view, which is so important to the welfare—not only as Dr. Hunt says—to the welfare of your State; he was too modest. The problem applies everywhere, all over the world, in my own country, too; and in this gathering here of fruit growers you do so very much good for your country, but you are not aware of the fact that we have the same existing conditions in my country—Palestine, which I believe is about one twentieth as large as California. We always listen with great interest to your proceedings; we are always very eager to get your publications, and I am quite sure that there are very few citizens in California who read with such interest the proceedings of your fruit growers' conventions as we do in Palestine, because so many of your problems here are the same problems we have to contend with. The problems of your University will largely influence the entire world. I am quite sure you are not going to mind that, and that you are going to do your best to help out on the problems of the world, because—noblesse oblige—you are so much better off here than other places in the world. I would like a few words on two questions which have been touched upon in the address of Dr. Hunt. He spoke of the importance of the Mediterranean races that will come to California and what will happen when they do come here. As a Jew, I belong surely to one of the oldest races of the Mediterranean. and as I have had good knowledge of all the agricultural and horticultural pursuits of the Mediterranean basin, I can imagine what importance it may have for California for the Mediterranean races to come here. I am sure that, no matter how large and how great a civilization you have developed here in America, the land would have had much greater influence from America if the beginning of American civilization in America had started on this side of America—the Pacific coast, instead of being on the Atlantic coast. I do not know if you here in California have read with as much attention as we have in my country a small pamphlet by one of your men on California, which we consider as being a good thing; it is by Dr. Jordan. I refer to the pamphlet called "California and Californians." When we Mediterraneans read the things as Dr. Jordan describes them, of the climatic conditions of California on the Californians, we understand better the influence of our climate on the Palestinians, and we can not understand how it happens that such a small country as you have heard that Palestine is, which is only a twentieth part the size of California, how it could happen such a remote country, such an old country, that two thousand years ago was interested in agriculture and even now is thoroughly interested and looking after the interests of human civilization. Well, you are twenty times as large as Palestine is, and we will hope that these people who come out to California will benefit humanity twenty times, even much more, and will bring benefit to the whole world. I hope that we will all be happy, not only because I want to be complimentary to California, but, as a Jew and belonging to the human race, I wish it for the human race all over the world.

I would like to say some few words on another point which has been made by Dr. Hunt of the study of the introduction of new industries in California. I am sure that these studies are of the highest importance for you, and that knowledge and the thorough study of new industries, even though you do not introduce them here, is absolutely necessary in order to make a success; and in order to illustrate what I mean by that I will give you a few instances of the failures you have had here in California, and which could have been avoided if you had known before what the conditions of the new industry you were trying to introduce into California were. Here in Fresno county, as every one now knows, what trouble you had in trying to introduce the Smyrna fig culture into California. Of course now I have just come from Asia Minor and can convince you, as the fig is so well established there. Now the fig is established here and you have succeeded so far that you are largely the very largest competitor to the original Asia Minor fig, but one of the difficulties you had was to establish the Blastophaga, and it took you twenty-five years from the first time you planted the fig coming from Asia Minor until the day you had your first crop of the Symrna fig. Mind, it took you a lifetime, a whole generation, to plant that, and why did it happen? Because we did not know and you did not know the importance of caprification. Caprification is a very old practice in the Mediterranean basin. Two famous travelers, explorers, Ollivier and Tournefort of France traveled in Asia Minor in 1870 and they described it minutely —this problem of caprification. They used to take the pollen, the blossom of the Capri fig and tie it with blue or red ribbons or strings to the Smyrna fig, and that was the way the figs were made to caprificate. Some people coming over and seeing these red and blue strings made fun of it, and said it was ridiculous, that it was superstition.

Let me give you another instance. You have for instance here in Fresno, where you are trying to develop what you call a Seedless Thompson, the raisins which are in reality a variety of seedless grapes which come from Smyrna and which have there a name very easily remembered—Tshakadaksez—or what you call in more comprehensive language, Thompson Seedless. Well you are trying to plant it here. I had an opportunity to speak with different leading men of the industry about the methods of preparing the raisins here, and the methods are very interesting, but they are not at all the methods followed in our country. There are a lot of details you do not know—your explorers did not appreciate—this gives you a good deal of trouble lots of times nearly all of you will find out that this will give trouble and cost you money and energy before you will find out what two thousand years of experiments have taught our people there. Therefore, I think that you should, before you introduce a new crop or industry here in your country, study the methods of the older countries, and this, I think, is of the highest importance.

I had an opportunity to speak before your County Commissioners, and I spoke of the carob tree. This tree has existed in the Mediterranean Basin for many years. I am sure you have all seen this tree; it is a beautiful tree; best ornamental tree you could have, the best introduced into California. But you consider it solely as an ornament, whereas we use it as food for cattle, fodder. We are four thousand years older than you in California and we are accustomed to all kinds of funny customs. We are accustomed to make use of everything we can and it pays to do it, too, and I am sure if you could have observed what we do in our country with the carob tree you would long ago have planted this crop in California. Let me tell you, the carob tree yields about four or five tons to the acre a year, and it is a very important forage crop in our country. It yields more to an acre than does alfalfa that you grow in California. In this country it is a new thing to the people, but the carob tree is thousands of years old with us—not a new thing at all with us, and it has been grown even in Europe for years. Very few of you are aware of the fact that when Napolean marched up into Russia his horses were all fed on carob crops, and the cavalry in Malta is fed principally on the carob crops; the horses used for the car lines in Naples have for their principal food the produce of carob trees and hundreds of ships loaded with the carob are sent out every year, from Cypress, from the old island of Cypress, to England for animal food.

As already said, we have had thousands of years' experience in agriculture in our little country of Palestine, and we Jews have had our part in teaching the world. I am sure that from a scientific point of view Palestine has not been exploited enough yet. We, as Mr. Chairman just now said regarding California's great institution, we are engaged in creating an institution, a Jewish agricultural experiment station, in order to find out what the real agricultural pursuits of Palestine are. The president of this station is one of the leading Jews in Chicago, and this Jewish experiment station is supported by many contributions from many of the leading and wealthy Jews of the world and particularly America. And this is one reason more why we feel in Palestine we ought to give every kind of information and assistance to hasten the agricultural work in America, and as California and Palestine are very similar in their agricultural conditions, we will be very glad to render every kind of assistance we can. Dr. Hunt said in his address that the problem confronting California is great, and that the University of California, the college of agriculture, deserves the support of every one in this State. I am sure that it deserves the support of every citizen of your State, and our Jewish experiment station, if ever you find it necessary, hopes you will appeal to us for support. As I have told you before we have something to learn from you, we of the old countries, and I am sure there is still something to learn in Palestine for you, even though you are twenty times as large as we are, and I hope that after you have learned all there is you will be able here in California to do twenty times as much.

SOME ORCHARD SPRAYING PROBLEMS AND EXPERIMENTS.

By W. W. Bonns, Riverside, Cal.

Mr. Chairman, Ladies and Gentlemen: When your State Commissioner invited me to address this convention some time ago, I accepted the invitation with some apprehension regarding the suitability of my place on the program. The agricultural and climatological conditions of Maine and California are about as different as those of any two of these United States can well be. Coming recently from the extreme northeastern state of the Union, I questioned if I might have anything to contribute to this meeting that would be of interest to the fruit growers of California. At the suggestion of Mr. Cook, however, that I discuss some phase of eastern orchard management or experimental work, I wish briefly to outline the results of some spraying experiments conducted in Maine apple orchards for the past two years.

The time has long passed when the necessity and value of spraying for the control of insect and fungus enemies of deciduous orchard fruits has to be proved. In the large regions devoted to fruit growing in the Middle, Central and Pacific Coast states spraying has long been an accepted part of the annual orchard treatment by all men who look to their fruit for an important source of their revenue from the land, and rightly so, for every year has shown them that spraying properly done means healthier trees, cleaner and better fruit, and, in consequence, better returns.

Spraying in its extension has also brought with it problems for solution. For many years Bordeaux mixture has been the standard fungicide for orchard spraying, with Paris green or arsenate of lead used in combination with it as the insecticide. Paris green has in recent years been largely superseded by arsenate of lead, because the former has a great tendency to burn and injure foliage, whereas lead arsenate has been found equally effective in destroying leaf-eating insects without the injurious effects upon the leaves. The increasing use of Bordeaux mixture has, however, been accompanied by reports of injury to fruit and foliage. Such injury appears to vary in degree and in different seasons. It has long been known that Bordeaux cannot be used with safety on the peach and the Japanese plum when the tree is in leaf. On the apple and the pear the injuries have manifested themselves in two ways—burning and spotting of the leaves and russeting and corking of the fruit. The leaves so affected show dead brown spots similar in general appearance to some fungus leaf spots, generally roundish or circular, but often irregular. Frequently the areas are large, as though a number of smaller ones had united. Occasionally the margins of the leaves show the characteristic dead blackened areas. Such foliage injury is very frequently followed later in the season by yellowing and premature leaf-fall. This occurs early or late in the growing season according to the severity of the injury. Sometimes it does not occur at all. Whether such yellowing is actually the result of Bordeaux spraying is a mooted point among investigators, but it is an acknowledged fact that it is frequently an accompaniment of leaf injury from this source.

On the fruit the injury is first seen as small, dark, flyspeck-like spots. These are not to be confused, however, with the spot of the scab fungus. The final appearance of the fruit may be well known to some of you. The skin is washed with a rusty or russeted coat which materially detracts from its appearance. In more severe cases the apple has been stunted in growth and has suffered malformation, while the russeted surface may be greatly roughened or even corrugated. In very severe cases the skin may crack and show V-shaped splits on the surface of the fruit.

Naturally, the increasing evidence of injury induced by Bordeaux mixture called forth a deal of investigation on the part of agricultural investigators in the several state experiment stations as well as in the Federal Department of Agriculture. As a result of such work, the following points seem fairly well established:

First—Bordeaux injury is a definitely recognized trouble.

Second—Improperly made Bordeaux is not the sole cause of injury, and excess of lime does not seem to have an appreciable effect in preventing it.

Third—Bordeaux appears to be aggravated in its injurious action by unfavorable weather conditions following the time of spraying. Wet weather so following is especially conducive to injury.

Fourth—Agencies such as frost and other factors not accounted for may produce a characteristic russeting on fruit, entirely independent of any spray.

Fifth—Varieties vary greatly in susceptibility to injury.

Sixth—The severity and general occurrence of injury in certain seasons of untoward weather conditions make it probable that weather is an important factor in causing injury. Even small differences of local atmospheric conditions may account for entire difference of results.

The means by which such injury is effected by the spray was also extensively studied by scientists both in this country and abroad. The differences of opinion regarding the actual method of injury have no place in a brief discussion of this kind. Suffice it to say that the fact accepted by all investigators in this field is that the copper of the copper sulphate in the Bordeaux mixture is the injurious element; recognizing this fact, the next step was to find a satisfactory fungicidal substitute in which the copper containing compounds would be eliminated.

In this effort attention was chiefly directed to solutions of sulphur in chemical combination. The result has been the now widely used and deservedly popular lime-sulphur sprays.

In connection with these lime-sulphur sprays it is interesting to note that a lime-sulphur mixture was recommended for the treatment of grapes affected with mildew as early at 1833, long before the general use of fungicides. This was the forerunner of the now well known "self-boiled" lime-sulphur mixture of Mr. W. M. Scott, formerly of the United States Department of Agriculture.

Two forms of lime-sulphur sprays have been used as fungicides since 1907—the self-cooked or so-called "self-boiled" preparation devised and first used by Mr. W. M. Scott, and the boiled solution first tried as a summer spray by Prof. A. B. Cordley of the Oregon Experiment Station.

Briefly, self-boiled lime-sulphur is a chemical and mechanical combination of calcium of sulphur obtained by adding sulphur to an equal weight of lime when that lime is slaking. The means of effecting this union is the heat of the slaking lime; no other heat is employed. The spray so made is not as strong as the boiled preparations, and has less sulphur in solution.

The boiled lime-sulphur solution is made by slaking good lime, and, after slaking, boiling with an amount of sulphur double in weight to that of the lime used. Actual boiling is continued from 30 to 60 minutes, according to the recommendations of various experimenters. It is known that calcium and sulphur will combine in different proportions and form different compounds; the greater the amount of sulphur present, up to a certain point, and the longer the time of boiling, up to about an hour, the greater the amount of sulphur in solution.

The commercial solutions are usually clear, but have not been found essentially different from the properly made home-boiled preparations.

The results obtained by Scott and Cordley proved an incentive to further work along these lines by the Federal Department of Agriculture, and station workers in several states where the fruit growing industry is of considerable importance. The results obtained by this group of men were again highly encouraging. Self-boiled lime-sulphur appeared to be an essentially safe and effective fungicide for the control of peach brown rot and scab, two of the greatest enemies of the commercial peach grower. It was fairly good for controlling apple scab, but not to the same degree as either the home made or commercial concentrated forms. In addition to their effectiveness as fungicides was the additional fact that they appeared to have little or no injurious effect upon the foliage when properly diluted, and no injury to fruit appears to have been reported. Both Paris green and lead arsenate were used, with the results in favor of arsenate of lead.

In the summer of 1909, the Maine Experiment Station acquired by state purchase a large and hitherto neglected orchard farm in the apple region of that state. The orchards thereon comprised about 3,000 trees, all of which were in most unthrifty condition and badly infested with insect and fungous parasites.

The first attempt at orchard renovation was a thorough spraying of all the trees. Bordeaux mixture was used, and, although the pests were brought under control, considerable injury, ascribed in part to the spray, was noted. For a large part of such injury the weakened condition of the trees, rendering them more susceptible to causes of injury of any nature may be held responsible.

In view of such injury, together with the fact that the Ben Davis is, unfortunately, still one of the big commercial apples of Maine, and is notably susceptible to Bordeaux injury, it was decided to test out, through a series of years, some of the forms of lime-sulphur solutions which had been so favorably reported in other places.

The questions to be asked by this experiment might be stated as follows:

1. Are self-boiled, home-boiled or commercial lime-sulphur preparations now on the market equal in efficiency to Bordeaux mixture for the control of apple scab?

2. May the damage from spray injury on susceptible trees, like the Ben Davis, be eliminated by such sprays?

3. If lime-sulphur sprays do not injure fruit or foliage, and yet are not equal to Bordeaux as a spray, is their use commercially profitable?

4. Can arsenate of lead be as safely and effectively used with these sprays as with Bordeaux?

These cover the really important questions in the lime-sulphur problem. It is, after all, of very secondary importance whether or not lime-sulphur as a fungicide may be advantageously substituted in the orchard for Bordeaux. The question of paramount importance is the determination of its relation and action in conjunction with a reliable insecticide. From the standpoint of general economy for the grower, the only solution of the spraying problem will be a safe and effective fungicide-insecticide combination.

For the experiment in question an orchard section of 140 Ben Davis trees, from 20 to 25 years of age, fairly uniform in size and condition, promising a moderate yield per tree, was divided into 12 plots and treated as follows:

2 plots, checks, unsprayed.
5 plots sprayed respectively with five different brands of commercial lime-sulphur.
1 plot sprayed with self-boiled lime-sulphur.
1 plot sprayed with boiled lime-sulphur, homemade.
2 plots sprayed with Bordeaux mixture of two different strengths.
1 plot sprayed with "Sulfocide," a proprietary article advertised as a soluble sulphur spray, not a lime-sulphur.

Arsenate of lead, used with all the solutions at the rate of 2 pounds to 50 gallons of spray for the first application, and 3 pounds in the succeeding ones, was not added to the several mixtures until the time of application. The sulphur containing solutions were, of course, diluted for use according to their respective densities, and the Bordeaux made up in the standard manner.

Owing to the nature of the experiment, a hand pump outfit was used. The three applications were exceedingly careful and thorough, and occurred when the fruit buds began to show pink, immediately after the petals fell and five weeks thereafter.

The weather at the time of the first application was most favorable. The days were bright, mild and calm. Between it and the second application no injury could be found on any of the plots.

The second application was interrupted and followed by weather of the kind most favorable for the production of spray injury according to previous experiences with Bordeaux. Showers interrupted and followed the spraying and the temperature and humidity changes were great and sharp. Cold, rainy periods were followed by bright, hot, humid ones. If spray injury were to be done, these were the ideal conditions for producing it.

Observations made two to fifteen days after the second spraying showed a comparatively small amount of leaf injury on all the sprayed plots except the self-boiled lime-sulphur. On those least affected it was found only by the closest observation; on others it was more readily seen, but on all the lime-sulphur plots which were affected the injury was so slight as to be entirely negligible, as far as the general health and functions of the foliage were concerned. The foliage was spotted to a vastly lesser degree than that of the Bordeaux plots, and although the spots averaged larger in size than those from Bordeaux injury, the individual leaves showed on an average fewer injured areas per leaf. The third spraying had no ill effect upon any of the lime-sulphur plots.

As the season advanced it was evident that so slight had been the foliage injury from lime-sulphur, even in the most severe cases, that to the general observer it passed unnoticed, and had no noticeable effects whatsoever upon the functions of the trees in developing fruit or wood. The leaves developed well, were thrifty and green, and, although scab could be found, it did not develop to an appreciable extent. No yellowing whatsoever was seen on these trees, and the leaves remained on them until long after the fruit was harvested.

The self-boiled lime-sulphur plot suffered no leaf injury at any time during the season. The foliage was notably thrifty and green. On the other hand, leaves as well as fruit seemed to be considerably more affected with scab, showing that the self-boiled preparation is not as effective as the boiled sprays.

Coming now to the fruit from these lime-sulphur sprayed trees, we found it notably larger, cleaner and of better color on the average that that from either Bordeaux or check plots. So far, therefore, as foliage injury and fungus control are concerned, the lime-sulphur sprays were a distinct success during the season on Ben Davis trees.

In regard to the fruit, none of the lime-sulphur sprays, not even the self-boiled, were entirely successful in preventing russeting or even malformation. In all cases, however, the per cent of deformed fruit was very small, and this peculiar fact must be noted: *it was in all cases but one no greater in amount, or less than that found on the unsprayed trees,* where the deformity was doubtless produced by natural causes. Hence it is difficult to say exactly how much of this deformity, if any, was directly due to the spray, and how much to agencies that caused the russeting and malformation on the unsprayed trees. However, it was only one third as great as that on the Bordeaux plots. Of one thing we may be reasonably certain, judging by past experience. When conditions are right for producing injury to unsprayed fruit by natural agencies we cannot hope to escape it on the sprayed trees.

The Bordeaux plots showed the characteristic effects on leaf and fruit. Leaves were badly spotted and the fruit russeted and severely deformed to quite an extent. The foliage very evidently suffered in thriftiness, as could be noted by the casual observer comparing these with the lime-sulphur plots. Moreover, there was a slight amount of yellowing and some leaf fall during the season, neither of which, as already stated, occurred on the lime-sulphur plots. No noticeable differences were seen between the trees of the Bordeaux plots of different strengths.

All in all, the lime-sulphur plots showed to decided advantage over Bordeaux in their effect on foliage and fruit and also in control of the scab fungus.

We come now to consider the one other sprayed plot,—that treated with Sulfocide. The injury done in this division was extreme. After the second spraying the leaves showed widespread injury two days after the application. The tissues were in cases thoroughly scorched. Defoliation was severe and the growing processes of the trees appreciably hindered for the season. Not only was the fruit badly damaged after the second application, but more injury was done it after the third, which was applied at a dilution greater than the weakest recommended by the manufacturer. The fruit was stunted in growth, deformed, and badly cracked and blackened at the calyx, or "blow" end. In some cases the calyx end was sunken, in others a similar burning of the tissues was found on the side of the apple, sometimes accompanied by splitting of the skin. Almost 50 per cent of the fruit on this plot was affected to some degree.

On the check or unsprayed plots, one at each end of the experimental block, scab played havoc on both fruit and foliage. In addition, these were the only plots where insect injury occurred to any extent at all. On all sprayed plots the arsenate proved most efficacious.

In taking the data for this experiment at harvest each fruit of the entire crop was carefully examined for traces of scab, deformity or insect injury. Without burdening you with tables, the results may be summarized as follows: The unsprayed plots showed 58 per cent of scabby fruit. The five commercial lime-sulphur plots showed an average of 8.8 per cent; the self-boiled lime-sulphur, 15.4 per cent; the home-made boiled solution, 14.7 per cent; and the strong and weak Bordeaux mixtures gave scab percentages of 16.7 and 14 respectively.

The Sulfocide plot showed the smallest per cent of scab—5.5. This advantage, however, is clearly offset by the huge per cent of deformed and burned fruit, namely 44.3. The amount of russeted and deformed fruit, as aforesaid, was no greater on the lime-sulphur plots than on the unsprayed ones, where the percentages ranged from 1.9 to 2.4. Hence no injury could be definitely ascribed to the lime-sulphur solutions. In the case of Bordeaux, however, the per cent of deformed and russeted fruit raises noticeably to 5.7 and 6.7.

A comparison of insect control showed 13.7 per cent and 7.3 per cent of wormy fruit on the unsprayed plots, and values ranging from 0.1 per cent to 1.9 per cent on the sprayed plots. The injury in the latter cases was done chiefly by the apple curculio, which is not a leaf or fruit devouring insect, and arsenicals are recognized as being of little practical use in its control. For the insects producing wormy fruit, therefore, the effectiveness of lead arsenate was practically 100 per cent.

The conclusions to be drawn from the above results were profoundly affected by some unknown factor, generally ascribed to the weather, which produced the severe russeting and malformation on unsprayed trees. Nevertheless, after taking this into account, the results tended to show the advantages of the lime-sulphur sprays, commercial or home-made, over Bordeaux in a season which put all spray materials to a severe test.

The experiment for 1911 was planned not only to secure further data along the lines indicated in the previous year's work, but also included several new aspects of the spraying problem. Some recent data in spray experiments tended to show that lead arsenate, in addition to its great insecticidal power, possessed some fungicidal value also. This was one of the new points of inquiry embraced in the second season's work. Another was the determination of the limits of dilution of lime-sulphur concentrates.

It is a well known fact that in using the lime-sulphur preparations instead of Bordeaux mixture in orchard spraying we are substituting for a spray that at the time of application is insoluble, one that is soluble and more or less caustic, according to the strength of the solution. The basis, therefore, for the proper use of the lime-sulphur sprays has been the determination of the strength of the stock solution, and its dilution for use according to its density. Simple instruments for this purpose and dilution tables graded for a scale of densities have been, and still are the only safe means of using lime-sulphur as a summer spray which, so far as known, will insure both fungicidal effectiveness and freedom from spray injury.

Nevertheless it is a matter of practical importance and interest to determine what may be the limits of dilution for a specific density, in regard to injury and efficiency; in other words, can a solution of a known density be safely used at a reasonably greater strength than that indicated by its place in the dilution table, or can it be diluted beyond the amount indicated in the table and still be an effective fungicide?

The trees used in this work of 1911 were the same as those of the preceding year. The plots being fewer in number, each comprised more trees. Two plots were sprayed with lead arsenate at two different strengths. Three others were treated with boiled lime-sulphur at three different strengths—one at the standard dilution, one 25 per cent stronger and one 25 per cent weaker. One plot was again reserved for treatment with Bordeaux mixture. All four were used in combination with lead arsenate.

It is impossible in the time at my disposal to go into all the details of the second season. Two factors were responsible for the prevention of any justifiable conclusions regarding insect or fungous control. These were a phenomenal season of drought and heat, which prevented the development of fungi, and an equally notable absence of injurious insects. This was proved by the many unsprayed orchards in the vicinity which produced fine fruit, without fungus blemish or insect injury. What relations, if any, the hot, dry summer had to the absence of insects is not clearly known; the extreme dryness easily accounts for the absence of fungi, which develop with difficulty under such conditions.

No rain fell from April 1st until May 24th. From that date until July 24th there was a total precipitation of but 5.1 inches, and the total rainfall from April 1st to September 29th was only 15.1 inches.

The season was also marked by an extraordinary heat wave during the first two weeks of July. Maximum shade temperatures ranged during this period from 95 to 103 degrees Fahrenheit—a condition which those of you who are familiar with New England weather will recognize as record breaking. As a result of this extreme heat much of the fruit on the south and southeastern sides of the trees, especially where well exposed, suffered severe sunburn.

I have mentioned this unusual heat factor and the resulting burning of the fruit because of its relation to the spraying question. The final application of spray occurred shortly after the subsidence of the heat wave. A small amount of russeted fruit was again found this year on the several plots as well as in unsprayed orchards in the vicinity of the experimental farm. It was negligible in amount and degree. But the fact is worthy of note that it was more severe on those apples which were injured by sunburn, and that the sunburned areas themselves showed further injury after the third spraying. Furthermore, this additional injury was equally severe on the sunburned fruit of all plots, regardless of the chemical nature of the spray applied.

A comparison of the lime-sulphur and Bordeaux plots for this season, aside from the question of insect and fungus control, again demonstrated the superiority of the former. Here had been a season, so far as weather was concerned, which was least liable to produce Bordeaux injury; and yet a noticeable amount of damage was done to both leaves and fruit, aside from sunburn. The fruit and leaves of the other plots were unusually fine, the fruit being of extra size, splendid color and texture of skin.

What deductions may we feel warranted in drawing from the results of the two years of experimental work just described? In view of the equal damage done by different sprays on the sunburned fruit in 1911, and the approximately equal amount of russeted fruit on sprayed and unsprayed trees in 1910, it appears evident that spray injury may be, and very likely is, due as much to a physical factor as to any chemical action of the materials comprising the spray; bearing in mind at the same time that there is a definitely determined type of injury in the case of Bordeaux mixture which *is* largely due to its composition. The physical factor mentioned is involved in the application of a spray or mist to growing plant tissues under extreme, or some now undetermined, but unfavorable meteorological conditions.

Granting the greatest amount of injury obtained under the conditions of 1911, the damage from the commercial standpoint was negligible in comparison with the advantage of annual crops of clean, worm-free fruit. Spray applications must, of course, be made at fairly definite, and in some instances, at very definite periods of the season. In times of unsettled weather or during very hot periods the orchardist must exercise his judgment with a view to applying his spray at an opportune time, both in regard to making it effective and at the same time to avoid all possible effects that might be induced by unfavorable weather.

One word more: If the account of experimental work in a distant state such as has been described has any significance to a gathering of Californians interested in the solution of their agricultural and horticultural problems, it is this: it is an illustration of the many and complex natural factors entering into such work. Such complexity, such varied combinations of Nature's forces means patient work over a long series of seasons in order that the final deductions may be based on a properly large average. It means patience on the part of the experimenter, and it means equally great patience on the part of the farmer and fruit grower. The problems of agriculture by their very nature cannot be solved by any short-cut methods to superficial conclusions. Both experiment station workers and orchardists thought they knew more about spraying ten years ago than they do to-day. That both classes realize this fact is the most hopeful sign that the spraying problem, like many others confronting us, will eventually be worked out to a successful conclusion.

Chairman Powell. It is due to carefully worked out problems of this kind that we are making our progress in the various lines of horticultural and agricultural activity. This has been an excellent paper, and it is now open to discussion; are there any questions you would like to ask before the next address?

Mr. Hassler. I would like to ask what proportions he uses of the lime-sulphur sprays.

Mr. Bonns. The proportions were made, of course, as outlined, according to the density of the lime-sulphur. In the first year's experiments we had different commercial lime-sulphurs and we tested all with the hydrometer to ascertain their density and we used them at the rate of one and one half gallons to fifty gallons of spray. In making up the boiled lime-sulphur the second year we made all our own lime-sulphur. and we averaged the same density as the commercial solutions and used it at about the same strength—fifty gallons of water, but of course that has to be determined. The compounds we happened to use that first year were those put on the market by various companies in the east.

FREIGHT RATES.

By R. D. Stephens, Sacramento, Cal.

I regret to see that my time is so limited in which to present this subject, but I think this is one of great importance, one of the greatest that will be discussed at this convention. It is a question involving how to market your fruits that you have been talking about, how to grow at a profit. We are talking about the developing of the resources of California. Dr. Hunt has spoken of people coming to California and investing money and exploiting California. You will find the solution of that question answered in this report. In order to obviate the unnecessary taking of your time, I have in condensed, minute form, which I will present to you, a report of your Committee on Transportation. I invite criticism, not only of the fruit growers, but also of the railroad officials with whom I am dealing. This question of rates that we are dealing with now will come up before the Railroad Commission on the twenty-third of this month, when I will come in contact with the ablest minds in this country and I am not afraid to meet them, because I know that we are in the right. My voice is not pleasant, and inasmuch as I will want about two minutes after this address is read, I would like to call upon some person, Mr. Isaac, for instance, to read my address, and then I will request your attention, take about two minutes, after he is through. Mr. Isaac, will you be so obliging as to read this address that I am to give at this meeting of the committee?

ADDRESS OF R. D. STEPHENS

Chairman of the Fruit Growers' Transportation Committee.

It is my duty as your chairman of the Committee on Transportation, to report what we have done, and what we have tried to do in your behalf, and the way in which we proceeded in our work. To perform this duty is not new to me, for I have been doing it for so long that it has become more of a habit than otherwise. Your Committee on Transportation first fought for the elimination of the private refrigerator car lines then used in the service of carrying our fruit to eastern markets. When we began the fight, the charges for refrigeration to New York were $150 per car, and $155 to Boston, and now the charge is $85 to New York and common points and $75 to Chicago and common points.

The contest was long, and sometimes became very interesting. Suffice it to say that ultimately we won a victory which gave to the deciduous fruit industry of the State an impetus resulting in increasing the volume of its products several hundred per cent. The increase in table grape shipments alone is about 600 per cent.

A New Committee

A new freight rate committee was appointed at the convention held at Sacramento in 1907, for the purpose of securing the same freight rates for deciduous shipments as were being given to the citrus growers and shippers.

The accomplishment of the purpose for which this committee was appointed was more of a task than it was at first thought it would be. However, it was not so difficult nor did it take so long—only three years—as did the elimination of the private car lines, and everybody would have been happy and comparatively satisfied had not the railroads arbitrarily increased the minimum for a carload from 24,000 to 26,000 pounds, and subsequently increased the weight from 26 to 28 pounds per crate for table grapes, which has the effect of increasing the cost of transportation about $29 per car to New York and common points.

The following figures show how rapidly the deciduous fruit shipments to eastern markets are increasing:

1903—24,000 minimum (about) 5,000 cars..................1,000 grapes
1904—24,000 minimum (about) 5,626 cars..................1,451 grapes
1905—24,000 minimum (about) 8,071 cars..................1,602 grapes
1910—24,000 minimum (about) 11,936 cars..................4,947 grapes
1911—24,000 minimum (about) 13,683 cars..................6,908 grapes
1912—24,000 minimum (about) 14,451 cars..................6,883 grapes

As the minimum, from 1903 to 1910, was 24,000, and 26,000 in 1911 and 1912, it is necessary to reduce the 1911 and 1912 cars to a 24,000 minimum to make a correct comparison of the season's shipments, which, when done, gives the above result, leaving off fractions.

The year 1912 was an off season on grapes. In many localities grapes set very light, and the damage done by frost and sunburn varied from 10 per cent to 75 per cent.

Acreage in Table Grapes

It is estimated that the acreage now planted to table grapes under normal conditions will produce from 15,000 to 16,000 carloads per annum in the near future, and it is self-evident that not more than one third, or, at most, more than 40 per cent, can be marketed at a profit to the growers as a whole, if existing methods under which they have been shipped are permitted to continue.

26,000 Minimum

The 26,000 carload minimum alone is sufficient in itself to bankrupt a very large per cent of the growers if they persist in trying to maintain their present acreage, and I am not prepared to say that under the most favorable conditions it will be possible to place the industry upon a paying basis as a whole. However, if it can be done, there are but two ways in which to proceed to bring about such a result.

The Only Way

First—Through voluntary action on the part of all the forces that possess the power to grant relief, of which the railroads are the most potent, for the reason that their resources for so doing are greater than all other combined.

Second—By appealing to the State Railroad Commission to take your contentions for relief to the Interstate Commerce Commission.

After having exhausted all possible means to get relief through the first we have invoked the power of the second.

That the railroad commission has the power to do this for you there is no question, for when the legislature of the State put upon its statutes laws granting to the State Railroad Commission full and complete power over matters and questions in which are involved the reasonableness of freight charges and methods employed in the transportation of interstate commerce, it had in contemplation the probability of conditions arising in which questions relating and pertaining to the transportation of California interstate freight shipments would demand the protection of the State.

Difficult

It would be very difficult to imagine the condition in which it would be necessary for the Railroad Commission to take action under the authority and power conferred upon it by the State, if this is not one in which the Commission would be justified in so doing.

Our committee has done everything in its power to bring about an amicable and satisfactory adjustment of all differences between railroad officials and growers regarding transportation matters. We had many conferences and meetings, but without beneficial results, so far as the growers are concerned. Failing to accomplish anything along these lines there was nothing left for us to do but to carry out your instructions to appeal to the Railroad Commission for relief in your behalf; therefore, in pursuance and compliance with your action taken at your last State Convention at Santa Rosa, your Committee on Transportation has appealed to the State Railroad Commission to prosecute your demand before the Interstate Commerce Commission, accompanied by ample proof of the justness of your cause.

Remember that it is not the duty of the Railroad Commission to take the initiative in this matter, therefore, much depends upon your action.

At the first hearing of your complaint before the Railroad Commission, it was charged by the defendants, the railroad officials, that 75 per cent of the shippers had not joined in the issue, and that there was no evidence that any considerable number of the growers complained that the rates and methods under which their products were being transported, were not satisfactory.

Since then, however, Frank B. McKevitt, manager of the California Fruit Distributors; C. B. Dewees, manager of the Earl Fruit Company; H. W. Adams, traffic manager of the Pioneer Fruit Company; H. A. Fairbank, manager of the Producers' Fruit Company; J. L. Nagle, manager of the California Fruit Exchange, have given their unqualified support to your contentions for reductions in the cost, and are emphatic in their demands for reform in the methods now in use in the transportation of your products.

As a matter of fact, the growers and shippers of deciduous fruit practically stand as a unit in favor of your contentions on file with the Railroad Commission, asking for reforms in the methods now governing the transportation of their products.

Changed Conditions

It has long been the custom for large and small shipping interests to pay a cash rent for vineyards and orchards and employ Japanese and Chinese to work them for a small per cent of the net proceeds from the sale of the products from the places. This per cent has been cut to so small an amount, in some cases to nothing, and other losses, that the Japanese and Chinese refuse to continue working under such contracts, with the result that many who have rented their vineyards and orchards will find themselves burdened with the responsibility of paying all costs of growing and marketing the products of their holdings, which, in many instances, will mean a loss to them if they try the experiment, and if they do not, then the conversion of their interests along other lines.

The Work and Its Cost

That you may have some knowledge as to the amount of work done by your Committee on Transportation, I will briefly refer to some of the many things we have done during the period we have served as members of the committee—since 1907, five years.

We made 125 copies of all letters and other matters sent to San Francisco traffic managers, and sent 87 of them to the officials of all the railroads that participate in the hauling of California fresh fruit shipments to eastern destinations. These copies were sent to presidents, vice-presidents, traffic managers, assistant traffic managers, and other prominent officials of these roads, and the balance of the 125 copies were distributed among prominent men of influence who might have influence with railroad officials. All this was done for the purpose of giving the managements of the roads an opportunity of learning the facts in regard to the conditions of the deciduous fruit industry of the State and the wants of the growers.

Some of our Annual Reports cost over $300, and yet our committee never asked for financial support. While the aggregate cost of the work done by our committee runs well into four figures, we have never asked for contributions from the growers.

Ask the Railroad Officials

If anybody thinks that we have "slept while on duty" let them ask the railroad officials, whom we count among our personal friends and who know better than any one else that we have been right in our contentions.

Realizing that the question of transportation, in its many phases, is the most important to those who have their capital invested in the production of shipping varieties of fruit, we deemed it necessary to print in pamphlet form the record of the proceedings of our committee since our last report made, one year ago, that you may have the opportunity of becoming informed as to what has already been done, and what it will be your duty to do to safeguard and protect your property interests from possible financial ruin.

Mr. Stephens. I wish to call your attention to the evidence that we are going to submit to the Railroad Commission, for reasons that we feel are good and sufficient, and that this minimum should be reduced. There are some twenty-five or thirty illustrations given in the report showing the difference between the upper and lower tiers of values. For instance, the lower tier in one case sold at $650, average price, more than the upper tier. That means that the intermediate tiers of course were damaged, and the very fact that there is any fruit at all damaged in the car is a detriment and an admonition to the buyers not to pay too much for it; therefore, that damaged fruit in a car is a great detriment to the interests of the fruit growers. I wish to call your attention also to a little item of two or three lines—switching charges made by the Southern Pacific for cars switched to the tracks of the Western Pacific—which is mentioned on page 15 of this report. The Southern Pacific certainly is very generous. It only asks 50 per cent of the full rate. For switching a car a distance of only about eight miles to the tracks of the Western Pacific, look at the excessive rates charged. Now this is an important question, and I want you all to realize its importance—you who are fruit growers and shippers. To Salt Lake City the Southern Pacific receives $68.77 for that little service. To Chicago it receives $59.54, and that, you must understand, simply for hauling that car only seven or eight miles, to the tracks of the Western Pacific. Now if the Western Pacific can afford to pay that heavy switching rate, and is yet desirous of getting the business, it shows that we should receive great deduction in transportation charges. This is a matter of interest to every man, woman and child in this State. Is it good policy to go ahead or shall we remain perfectly quiet and silent on this question and permit the Southern Pacific to drive out the great competing lines? It forestalls competition; it interferes with trade; it interferes with competition. Here is a road built at an expense of many millions of dollars that has come in and because of lack of traders it has to pay this great bribe to the Southern Pacific. I want every one of you to get a copy of this report and go through it very thoroughly, and you will find that we have given some startling facts. In this report is the correspondence had with the railroad officials and with different parties and our committee. In this report are letters from well known men, from McKevitt and others, endorsements of their ideas, to this committee. I am very sorry we are so limited for time in regard to this discussion. I think we ought to have more time in which to carry on this discussion. It is more important than anything else. You have known how to grow fruit for many years, but you haven't experience in marketing it at a profit. Now we must solve this problem, how to market our fruit—we must adopt some plan whereby our deciduous fruit growers of California can get their products into the consumers' hands. Remember when you go out this noon to take one of these reports with you. They will be on the table just as you go out.

Dr. Cook. It seems to me that we owe a great debt of gratitude to our friend Mr. R. D. Stephens. He has worked hard and faithfully and has served the fruit growers' interests of California for many years. We ought to have a vote of thanks now, and we ought to receive this report and place it on file with the secretary, and we also ought to thank him for his long and faithful work, and the committee should also be continued, and meet with this Transportation Committee on the twenty-third of December to take the matter up and talk it over, and try to persuade the commission on transportation to act for us and help us.

EVENING SESSION.

Dr. Cook, presiding.

CHAIRMAN COOK. We will now have the report of the Committee on Resolutions.

REPORT OF THE COMMITTEE ON RESOLUTIONS.

To the Convention: Your Committee on Resolutions to whom was referred the matter of preparing a report on the measures embraced in the address of the State Horticultural Commissioner, dealing with the various phases of California horticulture and pomology, submits the following:

The White Fly Quarantine.

Be it resolved by the California Fruit Growers in Convention assembled in Fresno, California, December 11-13, 1912, That we concur in the recommendations of the State Horticultural Commissioner that the sweeping quarantine against the extreme southern states and Texas making it prohibitive that all plants, scions, cuttings, grafts, general nursery stock coming from North and South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas, to enter California, be modified to include only such plants, scions, cuttings, grafts and general nursery stock known as host plants of the white fly; that in cases of non-host plants being transported, the same shall first be defoliated and submitted to disinfection by fumigation, spraying, or any other process of cleaning as shall be fully and explicitly prescribed by the California State Horticultural Commission. Said rules and regulations so laid down to always be in harmony with the provisions of the Federal quarantine law and the rulings of the Federal Horticultural Board at Washington.

Agricultural Education.

WHEREAS, The fruit growers of California, recognizing the great importance of agricultural education for our boys and girls;

Resolved, That we endorse the following suggestions made by Prof. J. B. Corcoran of the Fresno High School, and that copies of this resolution be forwarded to Dean Hunt of the University of California and to the State Superintendent of Public Instruction:

1. That state colleges require courses in education that will consider agriculture as a fundamental in education, and also courses that will familiarize those with practice in agriculture who are to teach in the high school on the grounds that it is fundamental and general, which will intellectualize farming to those who are to teach in high schools, who need a broader education rather than a so-called higher.
2. That in high schools where subjects are required, that agriculture be among them; or, if agriculture is not required, that none be required; and that colleges other than agricultural receiving state aid be asked to grant credit for work done in agriculture in high schools, which will result in a wider understanding and sympathy to develop between other callings, or so-called professions, and this most fundamental calling, on which all depend.
3. That all state normal schools that train teachers for the rural schools be asked to require as thorough a preparation in elementary agriculture, gardening, domestic science and such other vocational subjects as will enable those who are to handle children in the first eight years of school life, to train children toward their environment, instead of away from their environment, in such a way that farming will be looked upon as a profession as well as a vocation, and in such a way that children will, on entering the high school, be interested in and care to pursue farming as well as medicine, law and the other professions that they are now most likely to choose on entering high school.

Rural Economy and Development.

Be it Resolved, That owing to much unsystematic and unscientific methods in our rural industry, and a want of initiative in the development of undeveloped resources in the rural economies of the nation, this convention heartily endorses the provisions embodied in the Lever bill, now pending before the United States Senate, providing for demonstrations in the development, management and caretaking of orchard, vineyard and field crops; that each and every member of this convention will write to the California Senators, asking their support of this bill, and that the Secretary of this convention telegraph this resolution to the Cailfornia Senators at Washington.

New Legislation.

Be it Resolved, That owing to the multiplicity of county ordinances, each more or less at variance with the other, thus cumbering and restraining the economic and expeditious handling of commercial transactions, this convention places itself on record as in favor of a more uniform system of inspection and laws regarding the same, to the ultimate end that eventually we shall have a uniform system covering the entire State; that the various State and county horticultural authorities use every effort to bring this about as speedily as possible, thereby not only expediting the inspection of plants and fruits, but also in conserving, promoting, and developing horticulture and pomology along sane lines and with safety to all the interests concerned: that as a means to this end this convention advises that no new county ordinances be enacted unless first submitted and passed on by a committee of seven, consisting of the State Horticultural Commissioner, two members of the State Association of County Horticultural Commissioners and two representative California fruit growers, and two members of the California Association of Nurserymen. It is suggested that this committee be selected to give representation to the leading horticultural sections of the State.

Freight Rates.

WHEREAS, The Southern Pacific Railroad Company, by its unfair switching charges, discriminates against the fruit growers along its feeder lines; and

WHEREAS, Such charges are designed to cripple competing lines and to discourage fair competition; and

WHEREAS, Such discriminating charges are not alone injurious to our greatest California industry, but designed to retard our growth and prospects, and are plainly in restraint of trade; therefore, be it

Resolved, That it is the sense of this convention, representing the fruit growers of California, that the State Railroad Commission take this matter into consideration and lay it before the Interstate Commerce Commission for investigation and remedy; and be it further

Resolved, That the Committee on Transportation be requested to bring this matter to the attention of the State Railroad Commission, and urge upon it the necessity for immediate action, in order that this injustice to a large and important class of our products may cease.

Duplicate Manifest in Shipping Nursery Stock.

Be it Resolved, That we endorse the recommendation of the State Horticultural Commissioner that whenever a shipment of nursery stock of whatever description is made from one county to another within the State of California, the person, firm, corporation or agent making such shipment shall immediately send by mail a manifest of such shipment to the horticultural commissioner of the county to which said shipment is consigned. Said notice shall give the name and address of the consignee, and a full list of the stock contained in the consignment, together with the name of the state where stock was grown. If there is no horticultural commissioner for the district or county to which the stock is consigned, said notice shall be mailed to the State Horticultural Commissioner.

The Monthly Bulletin.

Be it Resolved, That this convention is heartily in favor of the continuance of the publication of The Monthly Bulletin of the State Horticultural Commission.

Employers' Liability Legislation as Applied to Orchard and Field Help.

Be it Resolved, That since the State Industrial Accident Board has given notice of an intention to endeavor to secure legislation at the next session of the legislature, which will make the compensation provisions of the Roseberry law compulsory on the employers of labor, whereby farmers will be compelled to carry heavy insurance to avoid bankruptcy under contingencies occasioned by such legislation; and that the Roseberry law and kindred legislation are based on the mistaken theory that all employers of labor can add the cost to the selling price of their products, thereby assessing the tax especially against the business of the country; and which from the nature of things bears an opposite economic relation to the business and manufacturing interests, being compelled to sell in world's markets without regard to the cost of production, a fact which will cause the larger part of cost of compensation liability to be absorbed by depreciating land values; and that such legislation unnecessarily and unjustly disturbs the relations existing between farmers and farm laborers, neither of whom have agitated in favor of such laws; that it is the sense of this State Fruit Growers' Convention that accident compensation laws, to be just, should operate to place the burdens of the same on society in general; hence, employees should bear a just share of the liability; and that we hereby petition the legislature to omit farmers from the class of employers that are to be brought under compulsory compensation; and that a committee of three be appointed by the chair to present this request to the legislature of California at its next session.

Examinations for Horticultural Commissioners.

Be it Resolved, That this convention, being keenly alive to the diverse conditions of soils and climates of California, and their corresponding variety of orchard and field crops, rendering qualifications largely local in character rather than general; that a knowedge based on years of experience and wide observation touching on these local or individual county conditions, which being of the first importance, this convention deems it inexpedient and unwise to make radical changes in the present system.

Resolution of Thanks.

Your Committee on Resolutions wishes to give an expression of thanks for the cordial feeling shown the convention on the part of the citizens of Fresno, as follows:

Be it Resolved, That the thanks of the convention are hereby tendered to the municipality for the use of the City Council Chamber as a meeting place;

To the enterprising citizens of Fresno for the automobile ride on Thursday afternoon, December 11th;

To the daily papers of Fresno, who have reported the convention fully in their columns, thus giving wide publicity to our deliberations;

To the Fresno Chamber of Commerce for favors extended;

For the many individual courtesies extended the visiting delegates by the good people of Fresno;

To the nurserymen of the vicinity for their efforts in our behalf; and

To the efforts of Mr. Schell in arranging the many details of this convention.

In Memoriam.

WHEREAS, Through the death of County Horticultural Commissioner A. R. Meserve, the horticultural officers and members of this Commission have suffered a deep, personal loss; therefore, be it

Resolved, That they express their sense of this affliction by causing this resolution to become a part of the record of this convention, and by sending copies of it to the different members of his family.

FRESNO, CAL., December 12, 1912.

WHEREAS, Through the death of County Horticultural Commissioner Linden Bree, the horticultural officers and members of this Commission have suffered a deep, personal loss; therefore, be it

Resolved, That they express their sense of this affliction by causing this resolution to become a part of the record of this convention, and by sending a copy of it to his mother.

THIRD DAY—MORNING SESSION.

FRESNO, December 13, 1912.

After an invocation by Rev. Thomas T. Giffin, the meeting was called to order, Dr. A. J. Cook, State Commissioner, presiding.

DR. COOK. The first address to be given this morning is on Drainage and Alkali Reclamation, by Mr. Frank Adams of the United States Department of Agriculture at Berkeley, but as Mr. Adams has not yet come in, I want to introduce to you Mr. Risser, who will give a short talk on the packing of grapes in sawdust for long distance shipment and storage purposes.

PACKING GRAPES IN SAWDUST FOR SHIPMENT.

By R. G. RISSER, U. S. Department of Agriculture.

There are approximately seven hundred thousand barrels of grapes imported into this country from Spain, selling at a price of about three million dollars, or something about four to sixteen cents per pound. The first grapes that were packed in redwood sawdust—the first grapes ever packed in sawdust—redwood sawdust at least—were packed by A. V. Stubenrauch of the United States Department of Agriculture, in charge of the field of pomology. He packed them three years ago, and since then experiments in that department have been continued, and commercial growers have now taken it up. This year twenty carloads of grapes were packed and shipped to eastern markets, Chicago and New York particularly; these were packed in sawdust for commercial growers. Last winter grapes that were packed in sawdust sold at auction for about $2.60, I think, weighing about twenty-seven pounds. This year grapes are being put up in drums, like you see here, packed in sawdust. The sawdust has to be mixed in with the grapes, in between the bunches and the fruit. A layer of sawdust is first put in the bottom of the drum, then a layer of grapes and then another layer of sawdust, shaken well down into the grapes, and so on until the drums are completely filled up. The cost of the drum is approximately about thirty-three cents. It is possible that by next year they can be packed in boxes that will cost probably about twelve cents, thus reducing the cost of packing. The cost of the sawdust at the present time is about thirty-five cents a sack, holding twenty-five pounds. That seems pretty high, but no doubt this will be reduced as the demands grow for it and the growers begin to pack their grapes on a larger scale. The cost of cork is, though, six to eight cents a pound. Sawdust is much lighter than cork, and it requires about half as much cork in weight as it does sawdust, so there is not quite as much difference in the cost of sawdust and cork as you might fear.

Some of the best commercial grapes for packing are the varieties known as the Imperial and Malaga; those two are probably the best. The Imperial will keep quite a little longer than the Malaga, until about the middle of January, but the first time packing in sawdust was tried they kept until about the middle of October. It depends a great deal upon the stage of ripeness the grapes are in when picked, and some varieties mature much earlier than others. In making tests of a great many different varieties, and with some less common kinds, our greatest difficulties were in the fact that we have competition with Spain, from whom we import a great quantity. This Almeria grape comes from Spain, and we have some here, and you can see, after the meeting, in what fine condition they are. Some of these grapes are Malagas and were packed in September, being now a little more than three months that they have been packed. We always test these grapes out after we take them out of the drum, out of storage, and about a week later in order to find out how much deterioration there has been during that time, and we find that there is very little deterioration, if they have been kept in a cold place after unpacking; but after a week, the deterioration is quite rapid. If there are any questions I can answer about this work I shall be glad to do so.

MR. ASHBURY. At what temperature are they put down?

MR. RISSER. It is hard to say exactly, about 32 degrees I should say, but we have experimented at different temperatures. The common practice was to ship under ice to the east. Some that are packed are being held here of course, but only a small amount.

MR. ASHBURY. Have you experimented on taking the grapes out of the sawdust and then putting them back, and what has been the result?

MR. RISSER. It has been our experience so far if we take them out and put them back in storage they will go down very rapidly. It is necessary to keep them right in that sawdust in which they are packed until ready for use. That would be the proper way, at least that would be my opinion as to that.

MR. SWETT. You think that cold storage is necessary or advisable with the Almeria grape? There is no cold storage used with the grapes shipped from Spain, is there?

MR. RISSER. They are shipped without ice to this country and held in cold storage. Whether the grapes in California or the common grapes grown here would be different I don't know.

MR. SWETT. They were held in cold storage and also without, is that it?

MR. RISSER. That has been tried before I entered the work. There have been a good many experiments conducted before my time.

MR. SWETT. About ten or fifteen years ago there were some investigations conducted by the Stanford University and there was found to be great variation in the type of grapes in the same vineyards. That is, they were not necessarily absolutely distinct varieties, but different strains, and I think it would be highly advisable if California ever wanted to grow that kind of grape to send again to Spain and select cuttings from the best type of this grape. About twenty-five years ago cuttings were imported into California and you have some of that type there now on the table. In the importations of Spain you will find certain grapes much better in grading, of large appearance and slightly different shape, but that may all be due to difference in environment.

MR. RISSER. We have a number of different kinds of the Almeria grape in the experimental vineyards, but I am not up on the same enough to give authentic information, but Mr. Schmidt, who is an authority on this subject, might tell us.

MR. SCHMIDT. We have several types of the Almeria grape — the Ojanez is generally considered the best variety. The Almeria and the Malaga are splendid types, but the Ojanez, so far, I believe, is considered the best variety of grapes here on the coast. I believe they would keep until April if put up in sawdust. It hasn't been tried as yet, but we are making experiments constantly, and we have some types here now that we are experimenting with.

MR. SWETT. Are they beginning to bear at all?

MR. SCHMIDT. They are, of course, quite young as yet, but they yielded a fairly good crop this year, considering the variety. We didn't think they would bear at all, but upon examination of the buds they showed that the fruit was spread a good deal from out on the branches, but pruning brought out quite a little, right around the crown of the vines. Well, we are going to put them up on this trellis system, seven feet high, as soon as we can get the vines large enough to put them on, and so we are going to try that way of pruning them—try that out. They did fairly well out here at Fresno's experiment station this year. They showed a little black spot which formed on the tissues. This is rather serious, and we do not know what it is. We have sent some fruit to Washington for examination, but as yet, as far as I know, no results have been obtained.

MR. SWETT. We have a few vines growing at Martinez where the trellis system is used, but they are so late that they do not ripen here before the winter sets in.

CHAIRMAN COOK. It is a great satisfaction I know to all of us that we have one as able as Mr. Adams to discuss this matter of alkali and drainage reclamation. Mr. Adams is of the Department of Agriculture, and he has given this matter a great deal of attention and is thoroughly conversant with this work. This address is being given by him at special request, and it seems there was some little difficulty—lack of time, I believe—but I wrote that he must come, so he is with us to-day. Mr. Adams, I am very glad that we have the pleasure of having you with us this morning.

DRAINAGE AND ALKALI RECLAMATION.

By Frank Adams, Irrigation Investigations, U. S. Department of Agriculture.

During the past fifteen or twenty years the owners of western irrigated lands and the communities dependent on them for prosperity have quite generally come to realize that drainage is almost as fundamental, even if not fully so, as irrigation. Many hundreds of thousands of acres of once highly productive lands have, acre by acre, been rendered wholly or partially non-productive through an excess of ground water in the feeding zones of plants and the consequent concentration at or near the surface of excessive quantities of alkali.

While this condition obtains in every western state, it is usually localized in those sections of each state where considerable quantities of water have been or are now being used, where the irrigated lands are relatively flat and distant from ample natural drainage channels, or where lands are so situated with reference to canals as to receive lateral seepage from them, as, for instance, when they lie at the base of relatively steep slopes across which canals are run.

If the excess of water that causes injury to a farm were merely that which the farmer himself applies in irrigation to his own farm over and above the immediate needs of his crops, little general injury would be likely to occur, because few farmers would continue long to add water to land already excessively moist. But it is usually the water that seeps from canals or from higher irrigated lands, and the coming of which the individual can not prevent, that does the damage.

Drainage Methods.

It would not be worth while for this convention to listen to a detailed description of the various methods that have been developed in this country for draining irrigated lands, even if the writer were a specialist on that subject. Those interested can obtain far more information than I can give by reading the various drainage publications issued by the Irrigation and Drainage Investigations of the United States Department of Agriculture, all of which can be obtained free on application to the Secretary of Agriculture at Washington. A few general observations as to methods may, however, be in place here, especially as they may aid in making clear the results of specific drainage experiments conducted by the Irrigation and Drainage Investigations and the State Engineering Department of California, near Fresno, to be taken up later in this paper.

Since the condition that makes drainage necessary is not due to the water applied directly in irrigation, but rather to the water that seeps from canals or higher overirrigated ground, the fundamental process in drainage is to intercept the excess water in its lateral percolation along some hard or relatively impervious substratum, or in its rise in the form of ground water. Consequently, the location and depth of drains is of prime importance. If it is feasible to intercept lateral seepage water before it reaches a point of injury, it is obvious that before locating drains the subsurface conditions must be looked into with great care. This simple fact is mentioned here because according to those who have been conducting drainage investigations it is very frequently overlooked. On the other hand, if the injury comes directly from below, by the rise of ground water, it is plain that drains must be large enough and deep enough, and, if of tile, so carefully laid as to both alignment and grade, that they will not clog, but will hold the ground water low enough to give ample feeding room for plant roots, and generally to prevent the rise of water by capillarity and the consequent accumulation of alkali on the surface. In damaged irrigated fields experience has shown that 6 feet is about a minimum depth for tile drains.

Where the adverse condition of excessive moisture has obtained sufficiently long to result in an excess of alkali, it is evident that in addition to drainage, assuming the natural precipitation is not sufficiently heavy to accomplish reclamation within a reasonable time, surface flooding is necessary to wash out the excessive salts. Sometimes both drains to intercept lateral percolation and drains to lower the ground water coming up from below are necessary in the same field. Again, where it is not practicable to place drains deep enough to collect water pressing up from below, drainage engineers consider it feasible to excavate pits 4 feet or more deep at intervals directly beneath the drains, which, when filled with gravel, readily carry the water up to the level of the drains. Occasionally, when water seeps laterally through gravel before reaching and causing injury to a field, collecting or ''relief'' wells in the gravel are sunk and connected to the drainage system. Where drainage waters can not readily be discharged by gravity it has been found feasible to collect them into sumps, from which they can be pumped into irrigation canals or other surface channels lying above the level at which it is desired to maintain the ground water.

Drainage Experiments in Other States.

Since about 1901 the Irrigation and Drainage Investigations of the Department of Agriculture have been conducting drainage experiments in the western states, until recently mostly under the immediate direction of Mr. C. G. Elliott, who for some years was Chief of Drainage Investigations. Experiments conducted near Fresno under the direction of Dr. Samuel Fortier, Chief of Irrigation Investigations, will form a later subject in this paper, but before taking them up it may be of interest to cite some of the results obtained elsewhere. Only brief mention will be made of such results as are cited, because the experiments are described in detail in Farmers' Bulletin No. 371 and in a reprint from the annual report of the Office of Experiment Stations for 1910, entitled ''Development of Methods of Draining Irrigated Lands.''

Eleven separate drainage experiments were carried on in Utah from 1904 to 1908, with some of them still in progress. A few of these only will be mentioned.

Hyde Park Experiment.

This covered two separate holdings, totaling about 31.5 acres in an affected belt of 2,000 acres, between Hyde Park and Logan, on which satisfactory yields had been obtained for twenty years prior to damage by seepage. The soil was black loam, underlaid with yellow clay, both of an open nature. First cereals and root crops gave way on account of seepage to hay grasses, the latter in turn being replaced by water grasses. Lines of 8-inch and 6-inch tile were laid 4 to 4.7 feet deep along the upper edge of the experimental tract to intercept the seepage from the higher lands adjoining, and a line of 5-inch tile was placed 4 feet deep lower down to care for the seepage that passed the upper line. Since drainage, yields of 50 bushels of wheat, 100 bushels of oats, and 18 tons of sugar beets per acre have been taken from the reclaimed land. The average cost per acre for drainage was $15.60.

Garland Experiment.

The area treated here was 60 acres, the soil being clay loam, underlain by separate strata of sand and clay and pockets of sand, and the tract itself being part of a flat depression separated from Bear River Canal by a stretch of sandy lands. The source of excess water was seepage from irrigation and the canal. Trouble began with a season of subirrigation, when the crops were record breakers. Then several acres became drowned out. Eleven farmers joined the Department of Agriculture in the drainage experiment. Both intercepting and outlet drains were used. Five-inch and 6-inch tile placed 4 feet deep led to 8-inch and 10-inch main outlets. The resulting improvement in this tract after drainage was very marked, not a trace of alkali showing. The average cost per acre was $16.87. Since this experiment was concluded a drain-tile factory has been built by neighboring farmers, because the tile the experiment proved were necessary could not be obtained within a convenient shipping distance. In addition, hand labor has been displaced in some cases by steam trenching machines suitable to the soil present and which excavate the trench to the full required depth at one passage.

Richfield Experiment.

This covered 80 acres in central Utah, the tract having a gentle slope of about 1 foot in 200. The source of seepage water was lateral percolation through a sand substratum from higher lands. Two parallel lines of 5-inch and 6-inch tile were laid 600 feet apart across the slope, with a few laterals of 4-inch tile to tap particular spots. The average depth was 5 feet. An open-trench outlet, first proposed to reduce cost, was replaced by a 10-inch pipe drain. Only the very highest portion of the 80-acre field was producing crops when the experiment was undertaken, the balance being covered with salt grass. After the work was completed a great deal of water was discharged, apparently from every part of the system, damp spots becoming dry and the spread of alkali stopped. The writer has not at hand the results of this experiment to date, but conditions were reported so gratifying that other projects were undertaken in the same locality, including the formation of a drainage district of 1,000 acres. One of the farmers in the tract subjected his land to a thorough leaching process and was confident of general success. The acre-cost in this experiment was $14.02.

Experiments Near Fresno.

It is not necessary to multiply instances from other states of successful experiments in draining irrigated land injuriously affected by the rise of ground water and alkali accumulations. This is especially the case since, as already mentioned, experiments have been conducted in the near vicinity of Fresno. The first work done here was on the Taft and Hansen farms at Fig and Central avenues, three miles south of the city, and was under the Bureau of Soils of the Department of Agriculture. The plan was to drain into a sump and then lift the drainage water into Central Canal by means of a 3-inch centrifugal pump operated by a water wheel in the canal. The first tile installation was partially unsatisfactory, but it was replaced by a larger one. The pump was operated for several years whenever there was water in Central Canal to turn the water wheel. This was not sufficiently steady, however, to hold the ground water at a sufficiently low level, because during the season of high ground water here a few hours only are required after stopping a drainage pump to have the ground water reach its former level. In 1908, owing to the unsatisfactory power supplied by the current wheel in the canal, a portion of this tract was connected with a new drainage system on the west and north, which was installed in that year on the farms of J. and Fred W. Hansen. This new system will be considered later.

Fresno Drainage Survey of 1902.

In 1902 a general drainage survey was made in the vicinity of Fresno by Prof. O. V. P. Stout, under the general direction of Mr. Elwood Mead, then Chief of Irrigation Investigations in the Department of Agriculture, in order to understand the engineering problems involved in the proper drainage of this region, the necessity of drainage being so evident that it was assumed. As a result of this survey two general plans for the relief of about 18,000 acres south and west of Fresno were prepared by Mr. C. G. Elliott, then Chief of Drainage Investigations. One plan involved 8 parallel open drains one half mile apart, extending from the eastern boundary of the district west to an intercepting drain leading to Fresno Slough, 20 miles distant. The second plan considered dividing the proposed drainage district into 18 subdistricts, averaging in size from 800 to 1,700 acres. Parallel lines of tile from 8 to 22 inches in diameter were to take the place of the open drains in the first plan. Instead of being carried 20 miles in a drainage channel leading to Fresno Slough, the drainage water was to be pumped from collecting sumps to the various irrigation canals. The estimated acre-cost of the tile system was $13 to $14, with that of the open system possibly a little larger. No action was taken by the Fresno farmers as a result of this survey and report.

Experiments on the Dore and Baker Tracts.

In 1906 additional work was undertaken by the Irrigation Investigations and the State Engineering Department of California in the Fresno lands needing drainage, the purpose this time being to show experimentally the benefits of drainage. Two tracts were selected for experiments, one of 20 acres at North and Elm avenues, known as the Baker tract, and one of 40 acres on the farm of Mr. John S. Dore, three and one half miles west and one half mile south of the Baker tract. The Baker tract is underlain unevenly with hardpan and the accumulation of alkali was thought to be as heavy as on any other tract in the affected district. About one half of the tract had never produced crops of any kind and practically no profits had been obtained from the rest for several years. The Dore tract, on the other hand, was a finely kept vineyard that had been very profitable but that had begun to fail rapidly, about one fourth of the vines being already dead.

The plans of the experiments on the Baker and Dore tracts and the immediate results obtained are fully discussed in Bulletin 217 of the Office of Experiment Stations of the Department of Agriculture. Both experiments involved the laying of main and lateral tile lines, ranging from 8 inches down to 4 inches in diameter, and leading to sumps from which the drainage water could be lifted by electric pumping plants and carried to nearby irrigation canals. The least depth at which the tile was laid was 3.5 feet, the average depth being 4.5 feet and the outlets into the sumps being 6 or 7 feet below the surface. The local difficulties encountered are fully detailed in the bulletin mentioned, including the necessity for blasting the hardpan on part of the Baker tract at a cost of about $10 to about $14 per acre. After the tile and pumping systems had been completed both tracts were flooded to a depth of about 12 or more inches. The Baker tract was flooded intermittently through the spring of 1907. On the Dore tract flooding occurred for ten days the first spring, and from the following fall to the first week in March, 1908.

Results.

Baker Tract.—Following the flooding and the operation of the pumping plant on this tract a marked improvement was apparent in the color and tilth of the soil. Two small tracts were planted to muscat vines, practically all of which lived and made a healthy growth throughout the first summer. The remainder of the tract was seeded about June 1st, four acres planted to sorghum growing spotted patches of fodder 8 or 9 feet high and yielding 1.5 tons per acre, the spotting being due to the presence of hardpan on the one hand and to the breaking up of some of this hardpan by blasting on the other. This tract has not been flooded since the time of the experiment in 1907 and 1908 and the pump has not been operated by the owner of the tract since 1909. Neither has the owner made any effort to cultivate or crop it since then, with the exception of seeding a small portion to barley the first season after the experiment was concluded by the Irrigation Investigations. At present the tract is abandoned to Bermuda and salt grass pasture and to the casual observer indicates a total failure of the experiment. But an examination of the tract, interviews with those who are familiar with it, and interviews with the owner suggest the very evident conclusion that, in spite of the exceedingly poor soil involved, largely due to the unfavorable hardpan condition, the plan of drainage was entirely satisfactory and that if it had been persisted in by the owner, instead of encouraging a return to Bermuda pasture, a permanent improvement would have resulted over at least a portion of the twenty acres. Rather than demonstrating the failure of drainage in this section, it is believed that the experiment on the Baker tract shows, first, that there are difficulties connected with drainage of the very poor land, and second, that thorough and persistent farming is as necessary as a good tile system.

Dore Tract.—When the experiment was undertaken on this tract in 1907 it was estimated by the owner that at the rate the vines were then dying the entire forty acres would become unproductive from the rise of ground water and alkali within a few years. Of 1,000 young vines set out in April, 1908, after flooding and draining, 95 per cent made a very strong growth and lived. In addition old vines that had practically ceased to throw out shoots began to do so, although these nearly dead vines ultimately succumbed. The old producing vines made a more healthy growth than for several years, remaining green throughout the summer instead of turning yellow with the first hot days of June, as before. According to Mr. Dore, an equally marked effect was then and has since been produced on the quantity and quality of the yield. The experiment was concluded by the Irrigation Investigations in 1909, but the tract has been revisited by the writer within the present week. The land has been neither flooded nor irrigated since 1908, and no new plantings of vines have been made later than one year following the period of the experiment. Some more of the old producing vines have died, several acres of the land thus bared being planted to pomegranates. Some of the pomegranates have also died, but those were located alike in the land most free from and most charged with alkali, and the owner attributes their failure to causes other than alkali which he can not explain. But the young vines that have been planted and that have not been injured by other causes have apparently made a highly satisfactory growth and beyond any question whatever demonstrate the entire success of the experiment. Some of the old vines are still dropping out in patches and it is evident, so far as conclusions are warranted from casual observations, that the land, which has had absolutely no surface water since the experiment was in progress in 1908 other than light precipitation, needs additional leachings. Owing to the continued low price of raisins Mr. Dore has not been encouraged to replant his vineyard where vines are missing, believing that possibly alfalfa will be more profitable, considering all circumstances. Consequently results are not available for young vines over the entire forty acres. Not one acre of Mr. Dore's tract has, however, gone back to pasture, for with the exception of a brief period each season when the ground water is highest throughout the district, the drainage pump has held it down to a safe level, in spite of the high level of ground water in all of the surrounding country.

Drainage on Hansen Farm.

During the progress of the drainage experiments on the Baker and Dore tracts part of the work was done, at wages, by a comparatively young farmer of the neighborhood who had seen his father's forty acres grow from a land of tar weeds to a $20,000 vineyard and then back again, after the rise of ground water and alkali, until for an entire year prior to 1907 it was carried on the market without a buyer for about one fifth of the former estimated value. What this farmer got out of his connection with the Baker and Dore tracts was more than his wages and his contract price for pumping water during the construction period. He got a knowledge of how to drain and an appreciation of the results that could be made to follow. He already had twenty acres of his own and about $600 in cash, and with the assistance of the Irrigation Investigations in laying out his system set about draining his own twenty acres, eighty acres on the home ranch, and an additional twenty acres adjoining which he purchased. Joining his neighbor on the south, whose forty-acre tract was in the original Taft-Hansen experiment of the Bureau of Soils, he changed the original position of the Taft-Hansen pumping plant, advanced $300 to the local power company to get their power line made accessible, and zig-zagged a 6-inch and 8-inch line of tile through the property from northeast to southwest to the collecting sump and pumps. One 6-inch lateral was run north into a corner of the sixty-acre home place; and an 8-inch lateral was run east to tap the land of his co-operating neighbor.

This homemade drainage system on the Hansen farm was laid in October and November, 1908. In 1909 ten acres were leveed, flooded, and seeded. This was added to by eight acres in 1910 and by nineteen acres in 1911, and the work of flooding an additional forty acres will be started as soon as water is available for the purpose in the canals. The acre-cost of the drainage system was $12 on the F. W. Hansen forty acres and $15 on the remaining eighty. Nineteen of the twenty acres purchased on borrowed money in 1908 in 1912 yielded seven tons of alfalfa per acre, according to the figures of the owner, which sold for $10 per ton, or a total of five times the original cost of the drainage system for the same area. This land was seeded in 1909 and 1910. Another nineteen acres seeded in the spring of 1912 and lying at the far diagonal corner of the tract, in the same season gave a measured yield of ninety tons of alfalfa, which if sold at the price brought by the alfalfa from the other nineteen acres, viz, $10 per ton, would have paid the purchase price of the twenty acres of which the nineteen acres is a part, plus the original cost of the tile drains. This land has been flooded and drained for three years prior to seeding. Of the nineteen acres, eight acres has received its entire irrigation water—it was irrigated heavily four times in 1912—from the drainage pump, sustaining so far as is possible with one season's work the conclusion of those who have from the first maintained, after numerous analyses of the drainage water, that the drainage water here is entirely satisfactory for irrigation. Starting in 1908 with forty acres and a debt of $1,800, this farmer, by applying knowledge he had gained through his connection with the Baker and Dore experiments, has in less than five years cleared his debt, built one barn and repaired another, and maintained a family of seven children from the profits of land that before drainage had an approximate value, as estimated by a conservative Fresno banker, of about $50 per acre. Of the land drained by the co-operating neighbor, sixteen acres of alfalfa seeded in 1910 yielded an estimated 100 tons in 1911 and an estimated 112 tons in 1912. A near-by twenty acres which is underlain with tile, but from which no water has been pumped for three years, is in salt and Bermuda grasses, yielding at the most seven or eight months of pasture at the rate of about two acres per cow.

Conclusions.

There lies in the general neighborhood of Fresno, as determined by surveys and studies of the Department of Agriculture, something like 200,000 acres of land now needing or coming to need drainage. In one form or another the story has many times been told of the well-kept avenues lined with beautiful shade trees which lead out from this city to the districts in which only dead stumps and Bermuda and salt grass pastures mark the places where valuable orchards and vineyards once flourished. Whether the former value of these orchards and vineyards was $350 per acre, as has been estimated by some writers, or only $200 per acre, as was yesterday estimated by a Fresno banker who has lived here many years, the social and economic changes that have come to the most badly affected districts are clearly evident. Whether these seeped lands, undrained and in pasture, are worth over $100 per acre, as some of the owners claim, or only $50 per acre, which is the highest price one conservative investor says he is willing to pay, it is plain that this fine city of Fresno could not long prosper if the surrounding farmers obtained no higher returns than can come from salt and Bermuda grasses. It is true that at the recent prices of raisins, many vineyards may face a loss on a season's operations, but what of the Bermuda grass grower when butter fat gets back, say, to 20 cents a pound? With the gross profits from such a price, how many pianos and automobiles can the Bermuda and salt grass dairyman buy after paying for the alfalfa his herd needs when there is no feed in the pasture? Nor is the question of drainage of interest only to the dairyman. How long can the real estate of Fresno City maintain its present high value, how long can there be fine libraries and fine stores here, how long can the county continue to hold its reputation for wealth and productiveness if the old landmarks among the farms shall permanently give way to the leaning gatepost and the decaying buildings of the alkali-affected districts? It is true that large areas about Fresno are not as badly affected as the section in which experiments have been made, and are producing heavily; but it is also true that some of these also may ultimately be affected.

That a feasible plan of drainage for the too-moist lands about Fresno is bound to come can not be questioned. The citizens here have frequently asked the assistance of the office with which I am in my small way connected, and the response made has been fully commensurate with the means of those in charge. Possibly the office can be of no further help. The experiments outlined in this paper, however, additional experiments in progress at the instance of the local power and irrigation interests, and the successful resort to drainage on the George C. Roeding and the Sunnyside tracts, seem to furnish all needed demonstration of the feasibility of removing the injury that has been done. Possibly difficulties not now foreseen will arise in carrying out larger undertakings than those now under way, but those who are professionally thoroughly familiar with drainage and alkali reclamation throughout the west, as well as here, declare the drainage of the sections about Fresno needing it, not only feasible and practicable, but fully warranted by the results that have been obtained elsewhere.

The formation of one or more drainage districts about Fresno has frequently been suggested. In fact, our drainage district act was drafted with conditions here especially in view. It is believed that the time has never been more opportune for action and accomplishment than now.

CHAIRMAN COOK. This has certainly been a most admirable paper, and will be read with interest by all in California, because in every part, more or less, there is this alkali land. Drainage in the land will be a great advantage, and certainly will be very valuable and not only could this work be carried on in Fresno, but in every part of southern California at great advantage, because there is considerable alkali down there, as well as up here. Land there became absolutely worthless, but they began drainage and washing out the alkali, costing about twelve dollars per acre, but now they raise wonderful crops of alfalfa. Ladies and gentlemen, we ought to have a stirring, lively discussion on this subject, and I hope you will all take part in it. Who will be first?

A MEMBER. We here in Fresno are thoroughly interested in this question. Twenty-eight years ago this drainage was first suggested in this valley. I should like to hear just a few words from Miss Hatch, who can tell us what this alkali has done for us here.

MISS HATCH. I cannot tell all the efforts I made to interest the residents of central California and arouse them to this danger, but to no avail. They said the expense would be greater than the valley was worth. But I was a resident and was one of the few who waked up to the idea that drainage was the only thing that would save us from destruction. I talked and talked with various residents here, but they wouldn't listen, and I have had this experience of seeing it go to destruction because none were ready to fight against it. That land to-day is largely given over to growing Bermuda grass and salt grass, and they all know that to-day—know what I told them over and over again years ago, and now they come to me and say, it happened exactly as you told us it would, and our land has gone because we neglected to realize what was happening and neglected to do anything for it.

Mr. Aaronsohn. The question of overflowing lands is not as dangerous with us, as we do not have any great quantity of water, and then there is another question. The art of irrigation cannot be acquired from the very start; it takes a long time for a farmer to learn how to use water on his land and in our country, where we have been engaged in agriculture thousands of years, nearly every farmer who has water at his disposal for irrigation knows how to make use of it, and, therefore, the danger of overflowing the land and bringing in too much alkali is not a problem with us. Still, in some parts of our country, especially in the southern parts of Palestine and upon the Dead Sea wastes of the Sahara, there are large quantities of salt in the water, and it happens very often that patches of land have been cultivated for a number of years that are so full of alkali that it does not pay to put any more crops on them. But then the natives have a very simple way of getting rid of the alkali. As you know, land is very cheap there; they rent this land for a year or two and wait until they have plenty of rainfall, and then the rain washes out the alkali from the soil, and generally our engineers and farmers come to this result—that before they begin to study a system of irrigation, when they come to realize that it pays to wait for the rains to drain off the alkali rather than to spend the same time, besides the great expense, to establish a system of drainage. Irrigation without drainage is considered in our country by the most progressive farmers as a very dangerous thing and leads to overflowing of lands, making it too rich in alkali. This idea of all irrigation engineers in theory has a splendid underlying principle, that they have to take care of the drainage question before they bring in water for irrigation.

Mr. Hutchinson. Speaking of the benefits of drainage. I only want to say a few words. That is, I was talking with the gentlemen to whom Mr. Dore delivered his raisins this year—Griffin & Skelley Company. His raisins were the best of any delivered to the packing-house this year. If Mr. Dore were here he could tell you something about the matter. I do not know what has been done previously, but this year, whether it came from the effect of his taking the best care or not I do not know, but I am perfectly willing to give the drainage of his lands the credit, and if many of our men living here would drain their lands, it would certainly be a very great advantage to all lands adjoining. We have heard Miss Hatch tell us about hers. I have heard her on several occasions talking of drainage, but she couldn't get any of her neighbors to take hold of the work. I am sorry she did not say what the damage was, but it was immense. I understand that only a few years before she was offered for that place of hers sixty-five thousand dollars. I think she sold it for about five thousand. I am not certain, I haven't her permission to say, but I want to show the people the difference between caring for their lands as they should, and joining together, draining certain sections of land and getting full value for it, and letting it go with no care or drainage whatever.

Mr. Adams. Yesterday I asked a banker here in Fresno, who had refused to loan a cent on certain land lying near, how much will you loan on that land if it is drained and planted in alfalfa? His answer was, he would consider it good security for ninety to one hundred dollars per acre at least.

Mr. Rixford. In regard to this universal condemnation of alkaline land, I want to say something in favor of alkali. We have discovered one plant that flourishes in alkaline land, and that is the date palm. I have visited the date garden at Tempe, Arizona, where the whole surface was white with alkali, and those palms were growing there to "beat the band." You can plant them when they are very young in strong alkali, but after the plants are two or three years old they will flourish in land that is so alkalined that none but salt brush will grow. I am satisfied that a good deal of alkaline land in the San Joaquin Valley will grow dates by planting the better varieties—the Rhars and Deglet Nours.

Mr. Stephens. There is a very important matter, one that the fruit growers of this State are deeply interested in, and I would like to take a few minutes' time right here. It is this Railroad Commission; whether the growers are back of this proposition, whether they want it and are willing to ask for it or not, and every fruit grower interested should be willing to attach his signature to this petition, and if the petition can be passed around and not interfere with the meeting and signed by the growers who wish to sign it, it would be a good thing. This is a very important matter, of more importance than any other action we have taken up here in this convention. If you want anything, ask for it; show that you want it, and if you do that you will get what you want. Show the Railroad Commission that you are in earnest over this matter and you are bound to get your rights. I hope every grower will attach his signature to this petition, and in so doing he will show that he desires the Railroad Commission to take this matter up.

Member. I would suggest that everybody take a copy of this petition home, that every county commissioner be requested to take a copy of this petition home and get signatures to it and then send it on to Mr. Russ Stephens at Sacramento.

Mr. Garden. I would suggest that the secretary ought to be in charge of this railroad petition and furnish a sufficient number of this resolution, so that the commissioner in each county can hand a resolution to each inspector on his rounds, and in that way I think he could reach every grower in the State.

CALIFORNIA CURED FRUIT EXCHANGE.

By J. P. Dargitz, Sacramento, Cal.

Ladies and Gentlemen: I believe that Dr. Cook has well stated the matter when he says this is an important question, and I should have been pleased if I could have had time to have prepared a paper which would very definitely cover the situation and put it in such a way that it would become a matter of record and be considered. Therefore, on such short notice, I shall simply have to give you a random talk and do the best I can to give you some leading points and allow you to do the necessary thinking to fill it out and make it sound as though it might have been carefully written.

This is an age of progress. In religion men are coming to do their own thinking rather than allowing the preachers to do it for them. In the matter of politics we have the evidence of progress about us every day. You know that the "elephant" and the "moose" both claim to be progressive now, and even that staid old character, the "donkey," is claiming to be progressive. Now, in the matter of fruit marketing, the growers are just beginning to wake up and realize what progressive ideas might mean to them. We have had progressive ideas presented to us in the matter of cultivation and propagation of fruits, until now we are producing in quantity and quality something that is worthy of consideration. We are not ready to take any back seat on these points, but in the matter of compensation for our efforts in that direction we lag behind. Furthermore, the fruit grower devotes his efforts and time toward producing the very best that he can, but has given no thought apparently to the matter of marketing his fruit. Now there is perhaps a cause for this, and that is the grower works individually. He works all day among his trees and vines, they are his companions, and when evening comes he is tired. Sometimes he will read a fruit paper, more often he wants to go to bed and rest. On the other hand, the people who are at the market end of the business are necessarily associated with each other, and they are continually studying the market end of the problem and sharpening their wits on each other. They are getting next to the proposition, and therefore are keenly alive to the situation, as they must be for self protection. We find that the retailers have their organized associations; we find that the wholesalers have their organized associations; we find that the lawyers are organized, and they name their fee bill; we find that physicians are organized, and they name their fee bill; and we find, in fact, that the hodcarriers are organized, and that they name their fee bill. We find the Japanese, who have invaded our sunny clime, have even organized, and when your fruit is ready to move they have got you; they name their fee bill, and you have got to come through. And, strange to say, the fruit grower is not willing to organize. He gives no thought to his fee bill until he is nearly starved to death and forced into it.

The conditions of the fruit market during this season have been such that the growers in many cases have been forced to wake up and take some steps toward adjusting the matter. What would you think of a man who never played a game of cards in his life, and who could not tell the names of more than three or four cards in the deck, that should attempt to go to a table and play cards for money with men who had had years of experience in gambling? Well, they would have him tied hand and foot. That is an illustration of where the fruit grower now stands, giving absolutely no time or thought to the determining of what he should have for his efforts and the product of his labor, and how he is going to get it. On the other hand, is a band of men who have, for several thousand years, been sharpening their wits in attempting to get the best of everything in trade, and they come and make a bargain with the fruit grower for his fruit. What chance has he? How can he hold his own? He simply cannot, and he has to take what the other has a mind to give. Unless the fruit growers will organize and by organization put the marketing of their fruit in the hands of some one who is qualified in a measure, at least, to meet these others on their own ground and on a fair basis, they will fail utterly. To succeed they must organize and then they can thresh it out; then there is some possibility of the grower getting what he ought to have for the product of his labor. Nothing in the world but organization will do it.

We heard Dr. Powell tell us last evening something about the orange and lemon business and how the growers of these products had combined and were able to market their fruit without involving speculation, and on the other hand he called attention to the fact that the lemons produced in Europe are handled on a purely speculative basis and so marketed. Do you know that the cured fruits, that is, raisins, prunes, peaches and apricots, and everything that is dried in that way, have been marketed up to the present moment on a purely speculative basis? Now, I am not here to condemn particularly the packers, because I am inclined to think that some packers at least are white men, who would be inclined to pay the grower all they can and be safe themselves. But let us suppose that one of these packers is named Smith, and Jones is another, and that Smith wants to do his best for the grower, and that Jones wants to do the best he can for Jones. Now what is the result under conditions purely speculative? Smith sends his buyers out to buy fruit, paying fairly good prices for it. Jones sends his buyers out, instructing them to buy at the lowest possible price, and to buy looking out solely for Jones. Don't you see that Smith, no matter what his good intentions are, is forced to do exactly the same thing that Jones does, otherwise, Jones paying far less for his fruit than does Smith, can go out to the trade and undersell him. Therefore, in speculative buying and handling, no matter how honest a packer may be, he is absolutely forced to fight for his own life by buying the fruit from the grower at the lowest possible notch that he can get the grower to take for it. It is all wrong; it should be turned around and the grower should put a price upon his product. The hodcarriers put a price on their product, which is simple labor, and they get it. The Japanese put a price on their product, which is labor, and they get it. And the doctor and the lawyer, the retailer and the wholesaler, all these people do the same thing, and they get their price, and why should not the grower do the same thing? Why is he placed in a class all by himself? Why is it the grower has got to do business entirely different from all the rest of the world? It is simply because he has not reached the point where he realizes that he must establish his own fee bill to be on a par with the rest of the world. It has been said that if the farmers got together they would corner the market and charge such enormous prices for their products that people could not and would not buy, and that the thing would go all to pieces. Now, perhaps, there is a little justification for such a conclusion. Farmers sometimes have done that thing in the past, but if the farmer by organization, by securing talent to look after the marketing end of the fruit, by gathering information on the crops and the market conditions of the world, of the available supply and probable demand, if he then will carefully name what is a fair price, based upon the absolute rule of equity and justice to every man connected with the business, from the man who plows in the field to the man who eats the stewed fruit, or has it on the table at hotels and restaurants, then there will be no question about the market.

Colonel Weinstock told me once that if a salesman came to him and offered him a certain line of shoes at the price of two and a quarter per pair and an agreement to maintain the market on them, or, on the other hand, offered him the same shoe at a dollar seventy-five and would give him no guaranty that the market would be maintained at that price, that he would take the two and a quarter price every time, because he would then know exactly where his competitors stood, and know that a competitor could not undersell him and so destroy his business. On the other hand, he would never know but that his competitors were underselling him.

Now, gentlemen, the matter of naming a price that is reasonable will just so surely win among the trade of the country when it comes to dried and cured fruits. The trade of the country itself is sick and tired of this matter of speculation, because while sometimes it means profit, it again means ruin to them, and they would gladly hear of a solution and fall into line with anything that would tend to maintain a reasonable price. Would not we all be far better off to get, say, six cents a pound for dried peaches year in and year out, knowing a definite price was assured, a price not higher than that, except in years of extremely light crops; would not we all be far better off than to get eight or nine cents one year and four or five cents for the next five years? You never make money when you produce dried peaches and sell them for four cents a pound; you can just as well let somebody else assume the problem for you and take the profits and pay the expenses, and you go visiting. You would be just as well off. When you get five cents you have got just enough money coming for your labor and investment. When you get six cents, you are making some money and you are entitled to it, and you are not making more in proportion then than other people who are doing business. Take the matter of raisins. No matter how low the price on raisins goes, the man who furnishes the shook, the man who furnishes the nails, the man who furnishes the labels, and the man who does the packing, as well as the broker who does the selling, they are all making their money. There is no difference at all in what they make, except the broker perhaps, who works on a percentage basis. Everybody makes something but the farmer, and it is time for him to wake up and take a position where he will begin to reap some profits from his labor. If prunes were worth four and a half and five cents possibly, last June and July, why should they be worth only two cents in October. The available supply for the world and available producing power of the world would indicate that the price should have been better instead of lower. The world supply of prunes for 1912 was less by nearly twenty per cent than it was for 1911, and yet the prices were going down. Why? Speculation. nobody could put his hand on the wrong and stop it. Just as soon as the prices on cured fruit under the speculative system start on the toboggan slide downwards, everything tends to push it farther down and faster. The trade will not buy when prices are going down. Why should they buy more than they need this week when they have an idea that next week fruit will be cheaper? And so they defer buying, and everything tends to make them stop buying. The minute you can stop that downward price and give the grower a chance to hold on, that minute you begin to strengthen the market. Then they get over their panic and prices are steadied. The trade is more anxious to buy two or three weeks' supply.

The Almond Growers' Organization, formed less than three years ago, has made very remarkable progress. I mention this because it shows what can be done. In 1910 they had two hundred and thirty members in their organization, and on the first day of September they had three cars of their crop sold. In 1911 they had three hundred and thirty members and on the first day of September had thirty cars of their crop sold. In 1912, on the 15th day of August, they had four hundred members, named their own price, and in forty-eight hours, one hundred and fifteen cars, all they had to handle, were sold. And this was the heaviest crop California has ever had, and it took but forty-eight hours to sell it. Of course that was not all there was to the story. Months previous to that the brokers and agents of the Almond Exchange had been at work. They had visited the trade and had taken orders subject to future prices. In making a good fair price, at least three cents a pound more than they would have received without any organization, they made what they considered a good fair price and the trade considered it so. Some people who had been speculating in almonds before realized that the business was slipping away from them, and they started out among the growers and attempted to discredit the organization. They said the organization had named a price too low, they could have gotten more money; they said the Almond Exchange was going to pieces, that members were falling out and that this was their last year. Well, that kind of talk acted like a boomerang—it sometimes does—and while we had four hundred members when we named prices, we have had sixty-three new members added since and not a single withdrawal. The Almond Exchange controls today a little better than sixty per cent of the crop of the State. And, friends, that is not all, it has set the price for almonds of the entire United States and all of the European almonds coming into the United States this year. Strange thing that it could do that, don't you think?

Now in the matter of cured fruit, surely this product can be handled in a similar way, because it is not perishable and we do not have to sell it the same day or the same week that it is ready for the market. It will take a long time to reach the point where we can control the situation as we do in almonds, because the product is so much larger. I think one of the mistakes that the farmers have heretofore made has been that they started in and wanted to do the whole thing in one year, and then became discouraged before really accomplishing anything. At present the Cured Fruit Exchange is made up of units or local associations organized in different districts. We want it understood that local associations or district organizations are units and a starting point, and that each handles its local business. They each have a representative and these representatives form and constitute a central body or exchange. The central body does the selling, other than that its work is purely advisory. It will assist the local organizations all it can, but local organizations are units and must assume their own burdens, and do their own business. We expect by this means to strengthen and educate them and fit them for taking their place in the world together with other people. The work of the central body is largely that of an advisory body, except that when it comes to marketing it has absolute control, and that is the only way it can ever be done and done satisfactorily.

I will give you just by way of illustration a little of the workings of the Almond Exchange at this point, because it shows how we have to grow into these things. During the first year it attempted to sell at the price named, and, by the way, it is one thing to name a price and another thing to get it from the trade. It takes two to make a bargain; the seller, the grower and his representatives, constitute the one, and the buyer constitutes the other; and they organize, get together and agree upon the price. Now if the buyer is the stronger man of the two, the tendency will be to bear the market. If the seller is the stronger, the tendency will be to push the market up; so you see the necessity for organization and co-operative marketing, having at the head of its selling department a man of strong character. When it came to selling the almonds the first year, having a small part of the crop and being forced to consult with one another, we frequently received offers just a little bit under the price indicated, and the idea was on the part of the representatives that not less than the price named was to be accepted unless they all consented, and we would have to call representatives in from fourteen different districts and cities, scattered widely, when we got an offer for a carload of almonds. Working in that manner you can easily realize our difficulties, and so that wouldn't work. Finally they got together and put it in the hands of three men, the manager, president and vice-president. And they said to the manager, when you get an offer you can telephone the other two men and get their opinion and approval to reduce the price. After that the manager 'phoned the others four or five times in this way, then the reply came back from both the president and vice-president to go ahead and do just the best you can; thus the work gradually was placed in the hands of one man. Make sure of your man, have the highest confidence in him; bond him so you know there is no danger of his selling out; protect yourself in every way possible, but put it eventually in such a manner that your representative can take his place at one side of the table and the buyer at the other, and then they can fight it out. Eventually that is where it will come.

Now regarding the fruit business, we started out about sixty days ago at the request of the fruit growers themselves. They were called together without previously considering the question of the dried fruit market. But it made no difference whatever to them—it was co-operative work generally, and it didn't take long to come to an understanding when we got to work, and we now have nine local organizations, formed and incorporated, and these are tied together in a central marketing body, known as the California Cured Fruit Exchange. This was incorporated the twenty-fifth of last month. It has already started in business. We began writing to a selected list of brokers, aiming to select our representatives in different cities. On Saturday we perfected and made our arrangements with our first broker. On Wednesday morning we received a telegram from him for a carload of fruit and wanted us to wire our price. Now, that is quick work. It only shows what can be done. The probability is that before the 1913 crop is ready to move we shall have brokers handling our fruits in not less than a hundred of the markets of the United States. We have already received letters from England and Holland, from people who are anxious to represent us. They have seen in the papers that we were organizing, and they were anxious to get in touch with the growers' organization. The object of the organization is not to eliminate anybody from the business who rightfully belongs there, but we cannot afford to have our business, our opportunities, and our just deserts taken from us by speculative commissioners who are in the business to make all they can get out of it and leave nothing for the grower. I saw a political cartoon recently which contained a splendid lesson. I am going to give a little of it, just for illustration. The trusts were represented by a big fat man; he was fishing. He had caught two eels, which were in a basket beside him; one was named the taxpayer, and the other was called the rent payer. He was just hauling in a third one, which was labeled the common people. The big fat man said: "I don't eat these eels—I just skin them and throw them back into the water so they can grow new skins. They have got used to it and don't mind it." Now, friends, that big, fat fellow represents the speculative element in the dried fruit market business, and the grower represents the eel, and they have been skinning us for years and years, and they think we have got used to it and don't mind it. They don't take all our money from us, but leave us enough to manage to live on and get more fruit for them to get a chance at again and thus make more money. The time has come to call a halt on that kind of work. The dried fruit growers of the State are beginning to wake up and call a halt. We do not propose to stand for it. We do not expect that we are going to get very much larger prices for our fruits through co-operation and organization than the growers on the outside will be able to get for some years to come. We have a long, hard fight ahead of us. We know that people who have been speculating in the dried fruit products of California are not going to see that business taken out of their hands without making a big fight for it. We know that. We haven't gone into this business with our eyes closed. Trouble is bound to come, and the problem will have to be threshed out, and it will take time, but we are going to do it and stick to it until we win, and we know we are going to win, just as certain as we know the sun is going to shine tomorrow, because it is founded upon that broad principle of equity and justice that will benefit every fruit man connected with the business, from buyer to consumer, and will injure no one who rightfully belongs in the business.

Chairman Cook. I do not, of course, like to disagree with Mr. Stephens, but I must say I do think this subject of organization is the most important subject that can possibly come up in any fruit growers' association. I believe that if the growers will organize, that Mr. Stephens will be out of business, and won't need to worry over the railroad tariff. Won't be any use for Mr. Stephens any longer to worry over the matter, because if they once organize they will control the situation. I have lived in California, the southern part, the past eighteen years, so you see I have grown up with the country, with California. I became very much interested in such meetings down there, and in every one of those meetings this subject, organization, was brought up for years, and you know these efforts created the California Fruit Exchange. And now, gentlemen, if you do not want, at every one of our fruit growers' conventions, to hear such splendid addresses as we have heard just now, then you want to vote now, because I propose at every fruit convention to have such addresses, because we have got to wake our people up about matters of this sort. So many farmers cannot do business properly, haven't been brought up to do it, and are defrauded every time. My friends, when the exchange had done eight million dollars business they lost four hundred dollars. I would like to see a business man in California that can show any such record. The farmers can by organization, and the exchange south has just got this reduced to a science and has cut expenses one third. They are packing everything at a cost of two thirds of what they did pay. That is a nice little sum; that would make good pin money. I hope you will all see that this matter is of very great importance. and I think it ought to come before every fruit convention. On behalf of the association I want to thank Mr. Dargitz for his splendid address.

Mr. Stephens. I certainly am in accord with every word that has been said by Mr. Dargitz, and believe it is a great thing if he can accomplish what he has set out to do; and if the growers will assist him in accomplishing that, they will have solved the problem of marketing dried fruits; but this has nothing to do with the marketing of our green deciduous fruits. They are both important. Now, the question is the value comparing the green fruits and the dried fruits. I agree with you, Mr. Chairman, that you people south of Tehachapi have accomplished wonderful things, and if the growers north of Tehachapi could be induced in any manner to come together and get in unison with your growers south of Tehachapi, they will solve the marketing question of the green fruit proposition, but they are handicapped in so many ways. The trouble with many of them, in some instances 75 per cent, they are in an impecunious condition. There was a time here that you couldn't borrow a dollar upon fruit lands, improved vineyards or orchards, from the banks—savings banks; and when you did succeed in borrowing a thousand or ten thousand, you had to enter into a stipulated agreement that you would ship every pound of your fruit with that association and with that organization. Now I say you cannot borrow a dollar excepting upon a certain high per cent of the value of the land.

I am pleased to hear that the almond interests have been placed upon a paying basis through the action and work of the Almond Growers' Association or exchange. I am a strong advocate for co-operation. I have the privilege of belonging to one of these associations. Mr. Humphrey is one member and I am the other. Years ago we took our business out of the jobbers. We happened to have enough to load a car, and we market our own fruit. We eliminate the jobbers from our business, with the exception, maybe, of a week or two at the beginning of the season, when we have to ship small quantities with the others. but we do our own business; we have our own agents. We have tried to get others with us; we invited others to co-operate with us, but the trouble was that the jobber would go around and give them rebates upon the commission and upon the shipment, and say, Don't you think you could do your business as well with us as with Stephens and Humphrey? When they got them into debt so badly they would have to borrow money from them, then they were no longer independent. I will give you an illustration. There was a neighbor of mine, a good business man, too, who was struggling along, in debt, trying to get out. He went to one of these interests and borrowed a certain amount of money upon a crop of fruit, with the understanding that he would ship his crop through that company when it was ready for market. Well, he had shipped his stuff from here for years, and he had lost. You see he had a crop of late peaches, and he always lost, year after year, so this year he went to the manager of the company and he said, "I find I can sell my peaches at so much a ton outside. Now I would like to do that. I have shipped them with you for two or three years and have lost." The manager said, "You have got to ship those peaches with us; you agreed to do it, and if you do not, we will put a man in your orchard and pack and ship them and charge the expense up to you." The grower said, "I will turn over the receipts to you, every cent I make on the peaches." "No, we are going to have those peaches and you have got to pack them, or else we will for you." And do you know, that man had to do it. That is the way some of our growers are handicapped here on deciduous fruit products, but they must be induced to come together in some way and organize into a co-operative association, like the Southern California Fruit Exchange, and then they would be masters of the situation. I wish to say, Mr. Chairman, that I am in hearty accord with the sentiments expressed by Mr. Dargitz and by you, and it would be a solution of this proposition, but we have got to have some sort of relief now, at once. The great impediment to the success in building up California is the Southern Pacific Railroad; I am not afraid to say it, either—many a man is, however. They come and pat me on the shoulder and tell me to go ahead, but they dare not do it themselves. That is the situation with us; that is what is holding this part of the country down all the time, as I tried to tell and explain to you yesterday. Look at the tariff; look at the revenue; they demand 50 per cent of the whole charge the Western Pacific receives for switching—that is, for hauling. Now the Western Pacific is ambitious to get business, and they send their agents out, their freight agents, and they go out and talk to us and to every jobber, and they come and say, "We want your business, we want you to ship with us," and they are exerting every effort possible to get the growers to patronize them. During the car shortage this season, of course, there was lots of freight hauled to and from the packing-houses. Everybody wanted cars. I tried to procure some, but they were short. A certain per cent went to Tassajara; some shippers there had been routing over the Southern Pacific, but on account of the shortage, some cars were routed over the Western Pacific. Well, the superintendent went right up there the next day, and he said, "This is not fair treatment; we have strained every effort to provide cars for you. There is a big demand for all the cars you used, and a great deal more in other localities in the south, and we have favored you, benefited you; we have considered you and we have given you your pro rata, and now you are shipping by Western Pacific. Is that right?" The result was, the next day the Western Pacific didn't get a single car. In talking with one of the officials, he said about that matter, "Do you know, Mr. Stephens, we hauled six hundred of those cars for the growers of California?" Now that is the method they use with us, and I do hope that every grower here, that every man that is interested, will have the courage and man-hood to say to the Railroad Commissioners, "I want you to take this matter up before the Interstate Commerce Commission."

MR. MARCHBANK. I think we ought to take advantage of that address. I believe it ought to be printed and every fruit grower get a copy of it. Too bad more growers won't receive it; that it will not reach the majority of the growers.

MR. SHEPHERD. I would like to ask how small a band of fruit growers organized could get into this one that the gentleman speaks of. I represent a small fruit growers' organization in our neighborhood, but I think they have no intimation or knowledge of this one that Mr. Dargitz speaks of.

MR. DARGITZ. The Cured Fruit Organization is quite new. It is only about sixty days ago that we started work, and it was only on the 25th of November that we incorporated the central body. Of the nine associations now incorporated and natural members of the exchange, I think the least one will have will be possibly three hundred tons of cured fruit—a fair crop—and the largest one will have perhaps three thousand tons.

MR. SHEPHERD. I think this organization I speak of will have about a hundred and seventy tons.

MR. DARGITZ. I do not think it would be wise to place any limit on it at all. The question is whether the growers in any community will get together and organize and incorporate under the plan that we have drawn up. That is the only question, and Mr. Jeffrey, the secretary of the exchange, is giving his attention particularly now to organization. I joined with him in that work until we organized the central body. Since then it has fallen to his lot to take hold of the marketing and build that up. We should be very much pleased to get in touch with you, and anything we can do for you we shall gladly do. I understand that during this convention invitations have been received from several different districts inviting us to visit them, with the view of organizing. It has been our idea not to take on members for more than, perhaps, ten thousand five hundred cars for the 1912 crop. We want to get thoroughly established in a small way, thoroughly acquainted with the possibilities of the market, and then we will be able to handle two or three times that amount next year. We want to gradually grow, not leap to the front all in a moment. If we take on too much this year and make a failure of it, the people on the outside will use that for a sort of club to prevent our success. We want to work it slowly but surely, and in such a way that the people on the other side will have absolutely no way of getting back at us.

Just one word more, if you will permit me. In regard to fresh fruit shipments. This organization is not in any way connected with the fresh fruit shipment work, only as it might be in a friendly relation. Mr. McKevitt and two or three other men who are in position to have accurate information, figured a few months ago that there are enough young orchards planted now of deciduous fruit on the Pacific slope—that is, including Colorado, Utah, Idaho, Washington, Oregon and California—that will produce within five years a hundred and forty thousand acres of deciduous fruit per year for the market. Just think of that. What are we going to do if we do not wake up and stand together, and attempt bringing the producer and consumer closer together and get a profitable price for the producer and cut down the cost to the consumer? By doing that we will increase the consumption wonderfully. As I understand it, some twenty years ago the orange market, with four thousand cars a year, was absolutely glutted and oranges went begging everywhere. Well, they organized, and last year marketed about fifty thousand cars at a profit. Is there any benefit in organization? Sure. Now, the work of the fresh fruit shipping interests can be handled much in the same way. They must take hold of the matter and must have a better method for the distribution of the fruit, getting it closer to the consumer, and the work that this Railroad Rate Committee is doing is tending in that direction. If they can get the minimum carload rate reduced, then they can put carloads of fruit into many additional cities in the country where they cannot get them now, because the carloads are too large and the fruit spoils. In that way it will benefit the growers. I cannot see anything encouraging, for a few years hence, in the fresh fruit shipping business, unless the matter of organization for better distribution and marketing is pushed to a very great extent. On the other hand, there will be such a tremendous amount of fruit that might be shipped in a fresh state, but won't because of the low market prices that will prevail, and this fruit will be dried and it will be thrown on the market as dried fruit; and here, for our very protection, for our life commercially, we have got to organize and extend the market. Now, just as an illustration of what this may mean: One of our growers went into a retail store in Oakland about four weeks ago with his daughter. She was married and lived in Oakland. He said to her, "Why don't you buy dried fruit? It would help us out very much." She turned to the grocer and asked the price of prunes. At that time the grower was being offered a price that would mean 2½ cents per pound for that class of fruit. The peaches that were being offered for sale were such that it would require but little stretch of the imagination to consider them first-class. Peaches at that time were bringing 3½ and 4 cents a pound for the grower. She said to the grocer, "How much are peaches worth?" "Twenty cents a pound," he said. "How much are prunes?" "Fifteen cents," the grocer replied. She turned to her father. "You have got my answer. I do not want fruit at that price." It is estimated that there were about fifty million pounds of cured fruit carried over last year into this year for consumption. Little of this was in the hands of the trade, none in the hands of the growers, and mostly all in the hands of the retailers. Now, owing to the jugglery with prices last year and speculation, the prices of these fruits were pushed way up so that the consumer had to pay so much for them. They were stale, old, and didn't taste good, and no one wanted to buy them. When the 1912 crop of prunes was ready to move, the retailers had this year's prices and a set of last year's on hand, and they said to the consumer, "You pay us our price for these prunes that we have carried over from last year, so that we do not lose our money on them, or we do not buy a pound of 1912 crop." That reminds me that when I was a little boy my parents at one time held me and made me take castor oil. I have never liked it since.

When the California Cured Fruit Exchange is in operation, in a year or two, I believe it will be in position, if anything of that kind comes up, to go right into the market and say, "If you don't put prices down where they will bring a reasonable profit to the grower, we will put a store right in here at once, and we will offer this fruit to the trade at reasonable prices," and we will until they do differently.

Mr. Nutting. Several of the members of our raisin exchange here have suggested that I ought to put in a word at this time. There are some believing that possibly the Dried Fruit Exchange which Mr. Dargitz has been speaking of might antagonize more or less the raisin exchange. Now, to state my position in that matter clearly, I will say that the telegram sent to Mr. Dargitz asking him to come here and state his proposition was written on my desk. The cured fruit business is very large, and I had no idea how large it was, or that it was as large as Mr. Dargitz says—140,000 cars for this coast. Why, when Mr. Dargitz was speaking on the Almond Growers' Exchange a few years ago, that they would have 115 cars, I thought our raisin business of five and seven thousand cars was large compared with the almond business, and now the dried fruit business, estimated at 140,000—why, the raisin business looks very small in comparison. I want to say again, that it was at my suggestion and informal invitation that Mr. Dargitz came here to present this plan of his. We want to do all we can to help it along, and I want to state that it will not conflict with our raisin exchange in the least—our interests are totally separate—but the dried fruit exchange for the whole State can go on and do a dried fruit business, get into shape, and it is going to be an immense thing, this plan of Mr. Dargitz, and I wish him success.

Mr. Aaronsohn. I must apologize for talking so much at these meetings of yours, but I am very much interested. I do not want to encroach upon your time, but I would like to tell you how, in Palestine, where we have such great natural resources, we suffer through lack of organization in the citrus business, and it is only in the last two or three years that we have tried to organize, and immediately the men who were in this organization began to feel the benefits and the good results of this co-operative work. Mr. Dargitz asked, a little while ago, if co-operation was worth while. There can be no doubt in any of us but that it is worth while.

Chairman Cook. We will now have an address by Prof. F. T. Bioletti, subject, "Increasing Returns of Muscat Vineyards."

INCREASING RETURNS OF MUSCAT VINEYARDS.

By F. T. Bioletti, Berkeley, Cal.

Grape growing in California is an industry in which the possibilities of production are practically unlimited and in which the competition among producers is uncontrolled. Under such conditions, the average price received by the producers for a series of years must be very close to the average cost of production. That this is actually the case appears from the following tables based on accounts kept at a number of vineyards in different parts of the State:

Cost of a Wine Vineyard.

	Coast.	Valley.
Land	$150 00	$150 00
Vines or cuttings	40 00	2 00
Preparation of land	5 00	5 00
Planting	5 00	2 00
Cultivation	12 00	10 00
Interest and taxes (8 per cent)	17 00	13 00
Cost, first year	$229 00	$182 00
Pruning	$3 00	$3 00
Staking (2 cents)	14 00	10 00
Cultivation	7 00	5 00
Hoeing and tying	7 00	5 00
Interest and taxes	21 00	16 00
Cost second year	$52 00	$39 00
Pruning	$5 00	$4 00
Cultivation	7 00	5 00
Hoeing, tying, sulfuring	7 00	5 00
Interest and taxes	24 00	19 00
	$43 00	$33 00
Crop, 2 to 3 tons, $22 to $12, less $6	32 00	18 00
Net cost, third year	$11 00	$15 00
Total cost	$292 00	$236 00

Returns of a Wine Vineyard.

	Coast.	Valley.
Cost of bearing vineyard	$300 00	$250 00
Interest and taxes (8 per cent)	$24 00	$20 00
Depreciation (5 per cent cost of vines)	8 00	5 00
Pruning	7 00	5 00
Cultivation	7 00	5 00
Handwork	7 00	5 00
Picking grapes	6 00	10 00
Hauling grapes	6 00	10 00
Cost per acre	$65 00	$60 00
Crop 3 tons, at $22.00	66 00	
Crop 5 tons, at $12.00	----------	60 00

Cost of production of wine grapes per ton: Coast, $22.00; Valley, $12.00.

Average price paid for wine grapes from 1902 to 1911 at three coast cellars: Cellar No. 1, $20.40; Cellar No. 2, $20.60; Cellar No. 3, $20.25.

The difference of about $1.50 per ton between the estimated cost of production in the coast region and the prices actually received is accounted for by the fact that the cost of production is increasing, owing principally to the necessity of using grafted vines in this region.

The estimated cost of $12.00 per ton in the interior valley is, I believe. very close to the average price which has been paid for wine grapes there during the last ten years, if we leave out of consideration the waste raisin and table grapes, which are often used in wine-making.

The grape grower's profit is what remains of the difference between the price paid by the consumer and the cost of production, after deducting packing expenses, transportation charges and the tolls of the various agents of distribution.

Often nothing remains, or, in other words, he is selling his grapes at cost and receiving nothing for his time and expenditure of energy. Not infrequently an examination of his balance sheet will show that his profit is a minus quantity. In fact, there are many vineyards in the State, both large and small, which an accurate system of bookkeeping would prove to be conducted at an average annual loss. This is possible on a large vineyard only by foregoing a reasonable rate of interest on the money invested, or by paying the deficit from some other source, such as the increase of value of the land. On a small vineyard, where the owner does most of the work, this form of unselfishness can be carried still further. He may not only obtain no returns on any capital invested in his place, but he may fail to obtain even current rates of wages for his own time and labor. In other words, he would be better off financially if he gave his vineyard away and worked for the man he gave it to.

That there are numbers of growers of wine, raisin and shipping grapes in the position of these hypothetical altruists is certain, and it should be useful to inquire into the causes and to point out, if possible, how the old grower can escape from this position and how the new grower can avoid getting into it.

The problem is how to insure a tangible residuum of profit after all charges, from the buying and planting of his vineyard to the last toll of the retailer, have been paid. Many factors enter into this problem. The least variable of these factors is the price paid by the actual consumer. In practice, this price will not vary much from the maximum which he is able or can be persuaded to pay. If it rises temporarily above this maximum, buying ceases and the price falls automatically. If it falls for a moment below this maximum, the struggle for profit of the various agencies of production, transportation and distribution quickly bring it back to its normal level.

The most variable of these factors is that with which the producer has the closest relation, the cost of production.

The profit of the producers, as a whole, will vary to a great extent in accordance with the more or less abundance of the crop, but the oscillations are such as to bring the average very close to zero. In other words, the average price obtained by the producer is not very far in either direction from the average cost of production. To change this general condition would require some very radical changes in methods of marketing, which it is not my purpose to discuss.

Even under present conditions, however, it is possible for the intelligent and experienced grower, aided by a little luck, to extract a tangible profit out of his industry. He can do this usually in one or both of two ways: (1) By decreasing the cost of production below the average; (2) by increasing the quality of his product above the average. In the first case, if the average cost of producing a ton of grapes is $12, and he can produce one for $10, he is clearly making a profit of $2 per ton more than his fellow growers. By improvements in quality, the gain is not always so direct, nor so immediate, but in the end is equally real. The consumer can be made to pay more for a superior article, and the competition of the distributors for this article will enable the producer to obtain some of this extra price.

The best examples of how the individual grower can increase his profit by diminishing the cost of production are perhaps to be found in the raisin industry. Our Californian methods of growing raisin grapes and drying raisins have been so simplified and perfected in the direction of doing everything as cheaply as possible that it hardly seems possible to improve in this respect.

A mistake made by many growers, however, consists in measuring the cost of production simply by the sums expended on an acre of vineyard. This does not vary much and in most vineyards has been brought very nearly to an irreducible minimum. The true way of arriving at the cost, however, is to compare the sums expended on the vineyard with the amount of raisins produced. If, by improving our methods of handling wines and raisins, we can increase the crop, we have diminished the cost of production. If, by expending $5 per acre on improved methods of pruning, cultivation, irrigation, and so forth, we can obtain grapes worth $15 more, we have increased the profit of our vineyard and diminished the cost per ton of grapes.

The cost of producing a pound of Muscat raisins has been variously estimated by different growers at from 1½ cents to 3½ cents. The general opinion places it at from 2½ cents to 3 cents. Accurate accounts kept by several large producers of raisins place it at about 3 cents. The grower who takes the trouble to keep accurate accounts, as a rule, takes pains to do the rest of his work well. The cost in a large number of vineyards will undoubtedly be more than this.

The cost *per acre* will consist of two categories: (1) Vineyard work, which alone is sometimes counted. This will amount to about $11.75 on the average. (2) Fixed charges, including interest on investment and depreciation, which will vary somewhat, according to the value of the land and the amount of raisins handled. The range will be from about $25 to $30 per acre. The cost of making raisins will be a little higher *per ton* with small crops than with large and will vary from $10 to $13 per ton in average seasons. Using these estimates, we can see that a pound of raisins will cost over 4 cents to produce in a vineyard yielding only half a ton per acre and only about 1½ cents in a vineyard producing two tons. In the first case, the grower will lose about $12.50 per acre, in the last he will gain about $58 at a selling price of 3 cents. With a crop of three quarters of a ton, which is probably above the average, he will barely make expenses. These facts are brought out in the accompanying table, which is based on accurate accounts kept in several large Muscat vineyards in the Fresno region. It shows that the estimate of 3 cents per pound as the average cost of production is not far from the truth, and that at this price, the average vineyard is conducted at a loss, but that the better vineyards yield a fairly satisfactory profit. While the average crop of a Muscat vineyard for a term of years is probably below .75 ton of raisins per acre, there are vineyards which produce as high as 1.50 tons or even two tons, and there is every reason to believe that under favorable conditions with the best management a crop of 2½ tons, representing 10 tons of fresh grapes, is not an unreasonable ideal.

Cost of Producing Muscat Raisins.

	Crop per acre in tons.					
	$.50.	$.75.	$1.00.	$1.50.	$2.00.	$2.50.
Pruning and burning brush	$2 50					
Plowing	3 00					
Horse cultivation	2 00					
Hand work	2 25					
Irrigation	2 00					
Vineyard work	$11 75	$11 75	$11 75	$11 75	$11 75	$11 75
Interest on investment	$20 00	$20 00	$20 00	$20 00	$20 00	$20 00
Taxes	1 75	1 75	1 75	1 75	1 75	1 75
Depreciation	2 50	3 00	4 00	5 00	6 00	7 00
Fixed charges	$24 25	$24 75	$25 75	$26 75	$27 75	$28 75
Gathering	$3 50	$5 25	$7 00	$10 50	$14 00	$17 50
Handling trays	1 00	1 25	1 50	2 00	2 25	2 50
Turning and stacking	75	1 00	1 25	1 75	2 00	2 25
Packing in sweat boxes	75	1 00	1 25	1 75	2 00	2 25
Hauling	50	75	1 00	1 50	2 00	2 50
Making raisins	$6 50	$9 25	$12 00	$17 50	$22 25	$27 00
Total cost per acre	$42 50	$45 75	$49 50	$56 00	$61 75	$67 00
Cost per ton of raisins	$85 00	$61 00	$49 50	$37 33	$30 88	$26 80
Cost per pound of raisins	$4 25	$3 05	$2 48	$1 87	$1 54	$1 34
Profit per acre at 3 cents	—$12 50	—$0 75	$10 50	$34 00	$58 25	$83 00
Profit per acre at 4 cents	—$2 50	$14 75	$30 50	$64 00	$98 25	$133 00

Owing to great variations in methods of cultivation, pruning and drying in Sultana vineyards, the cost of seedless raisins will vary more than that of Muscats, and I have been unable to obtain sufficient data on which to base an estimate of the average. A single example from a particular vineyard for a particular year, however, indicates that the cost is not very different from that of Muscats.

Returns of a Sultana Vineyard.

Size, 16 acres. Crop 1¼ tons.

Cultivation	$50 00	
Feed	150 00	
Pruning	150 00	
Vineyard work		$350 00
Taxes	$65 00	
Interest on mortgage at 8 per cent ($4,500—$281 per acre.)	360 00	
Fixed charges		425 00
Trays (handling)	$40 00	
Picking and turning	225 00	
Boxing raisins	25 00	
Making raisins		290 00
Total cost		$1,065 00
Gross income at 2¾ cents per pound		1,100 00
Profit		$35 00

This table shows that the grower sold his raisins at the cost of production, or perhaps below. While there is an indicated profit of $35 on the whole sixteen acres, no charge has been made for depreciation, which would amount to more than this amount on the trays alone. No allowance is made for depreciation of stakes and wire trellises, increased age of vines, or depletion of the soil, necessitating future fertilization. When these items are counted, the cost will come up fully to the 3 cents per pound for Muscat raisins. The owner of this particular vineyard probably did most of the pruning and cultivation of the vineyard himself, and also some of the raisin making. By this means he probably saved, at most, about $300 of the cost. This $300 represents the returns for his own labor. In order that he should be able to pay the inevitable depreciation charges and receive a fair return for his skill, energy and experience, he must receive at least 4 cents a pound for his raisins or increase his crop to at least two tons per acre.

If this reasoning and these calculations are correct, they prove the proposition with which we started, *i. e.*, that the growers of wine and raisin grapes sell their crops on the average at the cost of production. In other words, their returns represent simply current rates of interest on their investments and current rates of wages for their own labor. In the case of shipping grapes, undoubtedly similar conditions exist.

This might represent a fairly satisfactory state of affairs if it were uniform, although the grower has a right to expect some return for his intelligence and expert knowledge. The figures represent, however, only the averages of very widely diverging extremes. In some years the prices received are so good that the least skillful of the growers make a living, and the more skillful buy automobiles. In other years the prices are so low that many growers fail to receive enough to pay for harvesting their crops. This uncertainty of returns is very discouraging to the grower and prevents him from making those improvements in his methods which the proper development and future prosperity of his business demand.

The result is that too large a proportion of our viticultural output is of inferior quality. Too many green and moldy table grapes reach the Eastern markets; too much common and milk-sour wine is offered to the people who ought to consume the product of our vintages, and too many of our raisins lack the proper sugar, flavor, texture and size. In spite of these facts, all phases of the grape industry in California have increased with great rapidity during the last fifteen or twenty years. This increase has been due to our exceptional advantages of soil and climate and to the immense size of our natural market. However, we have done little to take advantage of our favorable conditions or to develop our markets. The industry has progressed in spite of our lack of properly directed efforts, and many growers have failed to receive any benefit from the development of their industry.

What do we need to improve this condition of things? We need, first of all, intelligent business co-operation on the part of the grape growers and of the manufacturers and handlers of grape products. By this means the currant growers of Greece, who were on the verge of starvation owing to the low prices received for their product, have raised the profits of their industry until it supports a large proportion of the population and pays a large proportion of the expenses of government. By similar means the grape growers of Argentina have kept the price of their wine grapes at between $26 and $52 per ton without any injury to the business of the winemaker, and while much improving the quality of their product.

Besides this business co-operation, we need, almost as much, great improvement in the general methods of our growers, packers and winemakers. The grower who, by care and intelligence, produces, packs and ships table grapes which arrive at Eastern points in excellent condition, is much handicapped by the masses of green and moldy grapes shipped by the careless and the ignorant. The winemaker who, by careful choice of varieties and the use of modern, scientific methods, produces a wine that is equal to the best of Europe, has to struggle against the bad reputation which Californian wines have obtained through the large proportion of spoiled and inferior wine produced by growers and winemakers who know, and apparently care little about, the varieties or methods necessary for good results. Similar conditions exist in the raisin business. Great general improvements are possible, both in the quantity and quality of the crops of our raisin vineyards.

Many of these improvements may be brought about by the general adoption by all growers of the methods now used by the most expert and progressive. Other and continued improvements are attainable by properly conducted experiment work and research. Great improvements in our vineyards are possible by more intelligent attention to the choice and preparation of the land; by a better selection of varieties and planting stock; by better methods of the cultivation and training of young vines; by more skillful pruning of bearing vines and, in general, by better work in all details of cultivation, irrigation, fertilization, control of diseases and the handling of grapes and grape products.

Grape growing and raisin making require intelligence, study and skill of a high order. Our raisin men have the intelligence, and all they need is the opportunity to study in order to quickly acquire the necessary skill.

In affording this opportunity the Viticultural Division of the College of Agriculture has done all for which it has had the means. Much more, however, should be done. The work of the college is known by only a very small proportion of those who could and would utilize it. We require more men and more means to bring to the mass of the growers that technical knowledge which they lack. We need more men and more means to solve those innumerable cultural and technical problems on which the improvement and future development of the industry depend.

For the last four years the State has made an appropriation of $7,500 a year for viticultural research. This has enabled us to establish small experiment vineyards at Davis, Kearney and Imperial, and to keep three or four investigators at work on some of the more pressing problems. We have published, during this time, three reports on special topics concerning the growing of grapes and three on topics concerning the handling of the product. Much of the work commenced is still unfinished, or of such a nature that definite results can be obtained only after several years.

This work should be continued and expanded. A reasonable increase of the state viticultural appropriation is necessary to provide for the continuance of the work commenced and its gradual expansion. Besides this, certain lines of work, which have been almost neglected, should be prosecuted vigorously. The most pressing need at present is an establishment where the correct handling of grape products could be taught to students and farmers, and where investigations into improved methods of packing and shipping table grapes, drying and handling raisins and the manufacture of grape juice, vinegar and other grape products could be carried out. Such an establishment would be most usefully situated at Davis, though a similar establishment adapted to handling somewhat different problems should be later placed in the San Joaquin Valley, probably at Kearney.

The building and equipment of such an establishment would cost between $10,000 and $15,000, and would require about $2,500 a year for running expenses. It would probably be well to combine similar work in other horticultural industries in the same establishment, at least at first.

The gross returns of the vineyards of California are, at present, not far from $15,000,000 a year. The United States alone would consume ten times this amount of our grapes, raisins, grape juice and wine if they could be supplied regularly, of good quality and at moderate cost. The cost to the consumer will depend partly on our adoption of the most economical and efficient methods of production, but principally upon a logical and uniform co-operative control of distribution. The quality will depend on the education of the producer in better methods and ideals, and, in this, the College of Agriculture should be one of the most effective agencies.

Mr. Dore. I would like to ask what per cent of sugar should the grapes contain when they are picked.

Prof. Bioletti. That is a question that I have been trying to investigate and trying to get the opinion of the farmers who have been raising grapes for many years, and they all seem to think it should be somewhere about 25 to 26 per cent. I have very little personal experience in raising raisins, and I have been trying to find out from farmers who have been making raisins for many years, and most of them do not know. A few of them think it should be at least 32 per cent, but growers who have really taken pains to ascertain the quantity of sugar seem to think that there should be 25 to 26 per cent.

Mr. Dorr. Have you told us whether there is some way that is practicable for the vineyardist of average intelligence and push to know what percentage their grapes contain when they are picked? Perhaps I am displaying my ignorance in asking this question, but I hope it will be beneficial to others as well as to myself.

Prof. Bioletti. It is a very simple method of determining the amount of sugar.

Mr. Dorr. I would like to ask the people here who live in Fresno County, who are practically all raisin growers, how many have found out or know how? I am curious to know that.

How many of you here have ever tested grapes to know the amount of sugar when you begin picking for raisins? (Seven members raise their hands.)

Prof. Bioletti. A matter of general public knowledge, then. It is a very difficult thing to do; it requires thought and intelligence.

Mr. Kaller. What do you think would be the most important thing to do to improve the production of raisins? There are various things that can be done, of course. We all know that pruning will greatly improve them, and that is what most people probably have been doing. But what about our ground? A good many of us here think we have tilled it, and a good many of us think that we have been working with virgin ground; but I do not think our ground is so virgin. It has been used a great deal for grain before our grapes have been planted, and I want to have your opinion: what you think would be most important in improving production.

PROF. BIOLETTI. There are so many things that can be used with benefit, and it is a mistake to say which would be of real importance. In one section there is one thing, and in another something else. Our growers don't study their business enough. Make a study of your ground, of pruning, and in doing this you could increase your production all the way from 10 to 25 per cent all over California. That is the only way you can do it. You have got to study, correspond with the agricultural stations; get all the books you can on the subject; see what others do and keep track of what you do yourself. Give support to the agricultural experiment station until they have got means and men to bring this kind of information to every fruit grower in the State. This is the means of getting this information, which is now in possession of the best growers of the State.

MR. SESSIONS. I am interested in shipping grapes. I see that you have the cost of handling there as 73 cents. The grapes I shipped this year cost, after they were delivered at the packing house, 74 cents and a fraction, and my cost of picking and hauling were additional to that.

PROF. BIOLETTI. Those are figures based on the report of Mr. Stubenrauch and he is responsible for these figures, and the report was given, I think, for the use of the Interstate Commerce Commission. These were figures based on the account which Mr. Stubenrauch obtained from various growers.

MR. SHEPHERD. I am not in the grape business, but we citrus people know very well not only how to prune, but to fertilize. We know just about what to put into the soil to make our crops fine, and I was thinking that the same conditions ought to apply to grape culture, and I believe, if our friends would study or look into the matter of what the grape needs, they would produce better crops. Supply what the grape contains and put that into the soil; you would have very much increased production. We know that you cannot have oranges, and year after year take off crops from your orchards and return nothing. We have to put in phosphoric acid, nitrogen and potash into the soils. Now there must be something that the grape takes from the soil that you have not replaced, and I believe that, if the vineyardist of the Fresno district, and every other district, could appreciate how valuable fertilization is to the citrus business, every one of them would go to work to-morrow and investigate that question, and there is no question but that you deplete your soil Your soil here is very sandy, more than ours. We have to put in humus and cover-crops, and supply nitrogen, which you know the soil needs, and there must be moisture in the soil. I hope that our friend here, who came from abroad to invest his money and engage in the grape business, will take up the matter of fertilization. You can get plenty to read upon it, and any one, any manufacturer, without mentioning any names, who understand trees or any subject of horticulture, can tell you just about what your soil needs.

Mr. Kaller. Before I say anything further I want to say that I have read every bulletin issued upon any subject. I have had my attention called to various bulletins that have been written on this subject, on any subject that is of interest to the grower, but when I came here I came with the information that I was meeting a virgin soil. And men come here and are brought here and allowed to invest here, thinking, and are made to believe, that they have to deal with perfectly virgin soil. It takes a few years before you come to the conclusion that you have made a mistake and that your soil is not virgin. They have to begin investigating in an attempt to find out what is needed, and I have been here now six years, and two years ago only found out that fertilization was needed. There are hundreds, thousands, of people that have come here who are utterly unable to cope with this condition, because when they buy their vineyard they go in debt, and I think it is the curse of this country that too many poor people are brought in here believing that they have to deal with soil that will yield crops, and they know nothing about such work as fertilization or other work that Professor Bioletti has told us about. They have come, starting down at the bottom, and are unable to stand the cost; they started in, many of them, in debt, and didn't have anything to go on with. And I say, while I appreciate your country very much, it took me four years before I found out that there must be something else. I have done everything on my vineyard that I could, and when I found it did not grow and produce to my satisfaction, then I took a piece of soil up to Berkeley and had it analyzed.

AFTERNOON SESSION.

Chairman Cook. Our first address this afternoon will be given by Mr. Frank T. Swett of Martinez on the subject of "Viticulture in the Interior Valleys."

VITICULTURE IN THE INTERIOR VALLEYS.

By Frank T. Swett, Martinez, Cal.

If the 1912 prices for Tokays and Malagas had been better by $300 a car; if the wine grapes of the San Joaquin had brought $14 a ton instead of $6 a ton; if raisins were above instead of below the cost of production, it would be a delight for us all to consider the best ways of increasing and making permanent a greater vineyard acreage in the vast valleys of the interior.

It would then be worth while considering the best ways of controlling that capricious and unsatisfactory pest, the phylloxera, which works with unremitting energy in the Coast counties, where grapes sell for $16 a ton, but takes things easy in the sections where grapes are worth only a trifle more than the cost of picking and hauling.

Were it not for the work of the phylloxera there might be an overproduction of grapes in the coast counties, but, owing to its steady progress, hundreds of acres have gone and are going out of existence each season, so that prices bid fair to be good for many years to come.

The great viticultural industry of California, with its triple alliance of wine, raisin and table grape production, is passing through a period of deep and serious depression. Previous to 1907 it had its seven fat years of prosperity, but since then there have been five years the reverse of fat, if financial returns and not tonnage be considered.

With the great stampede of planting, rash and inconsidered, beginning about 1903 and ending in 1907, the production of raisins was jumped from ninety million pounds in 1905 to a hundred and twenty-eight million pounds in 1911; that of wine from twenty-six million gallons in 1905 to fifty million gallons in 1911, and that of table grape shipments from sixteen hundred carloads in 1905 to sixty-three hundred carloads in 1911, almost quadruple.

There are about fifty thousand acres of table grapes in California, mostly in full bearing. Assuming an average of five tons to the acre, this would give about two hundred and fifty thousand tons of grapes, or the equivalent of about twenty thousand carloads, if all were harvested and packed.

But this year only about sixty-three hundred carloads were shipped east and perhaps seven hundred carloads to a thousand carloads consumed in California, accounting for a total of about seven thousand carloads. During October and part of November markets were badly glutted. Increased shipments would have still further demoralized markets. What happened to the remainder of the table grapes? An immense tonnage was either turned into the wineries at utterly unremunerative prices or were not picked at all.

The table grape business is a little brother of the wine grape business. While at first sight it might appear to be independent of it, anybody can see that if the wineries did not consume the great surplus of lower grade table grapes, these grapes would be forced into the table grape markets. to still further demoralize sales.

Existing markets are not consuming under present conditions of packing and distribution much over seven thousand carloads, even at low prices. With an acreage sufficient for twenty thousand carloads, what is California going to do with the odd thirteen thousand carloads for which no present markets exist? In the face of competition with the two hundred thousand tons of Concord and other grapes grown in New York, Pennsylvania, Ohio, and Michigan, can we look forward in the near future to doubling or trebling the consumption of our California table grapes?

What can the table grape people do about it? If wine grape prices were attractive it would be easy to graft a large acreage of Tokays and Malagas in places where quality is low into Petit, Syrah or other desirable types of grapes. But at offered contract prices, which I am told is ten dollars a ton, there is no inducement whatever to do this, for on most land ten dollars a ton is below the cost of production, if interest on the investment is figured in and, of course, it should be.

In certain localities, where soil conditions are favorable neither to the production of large crops of table grapes, nor high quality, some reduction of acreage is inevitable. In fact, frequently these places are well fitted for the production of paying crops of alfalfa. Through the extension of irrigation ditches or the installing of pumping plants operated by distillate or electric power, it is now becoming possible in many localities to thus produce paying crops of the safest and surest crop in California—alfalfa.

High grade table grapes usually sell at a profit; second grade grapes, such as poorly colored, compact-clustered Tokays, which mould and rot in the center of the bunches in transit, usually sell at a loss. If a grower finds that one part of his vineyard produces this undesirable type of grape, the sooner he digs out or grafts out that portion the better. There are many vineyards now for sale at about two hundred dollars an acre, which, if in alfalfa instead of vines, would be worth three hundred dollars an acre. Some of the best alfalfa land makes the poorest grape land. Type of soil has much to do with the selling price of grapes.

In the New York sales catalogues there is frequently a difference of three hundred dollars a car in sales of grapes shipped from the same district, packed the same, handled the same, and the same variety, but grown on different soils. One line will be selling for seven hundred to eight hundred dollars a car, returning no real profit whatever, while another line, grown on different land only a few miles distant, will sell at eleven hundred to twelve hundred dollars a car, netting the grower handsome profits.

So great is the difference in selling prices that it is quite likely a few years from now that further planting of table grapes will be carried on on the black lands south of Lodi, while at the same time the grub-hoe may be at work on other vineyards almost within rifle shot.

The grower who is up against it financially, owing to the disastrous prices of the last five years, cannot afford to make sweeping changes. In many cases his ready money and his credit are almost exhausted. The small vineyardist owning ten or twenty acres and nothing else, situated where he cannot grow quality grapes, is in a serious predicament. He needs all the counsel and guidance and help that can be given him, not only by the county horticultural commissioners and by farmers' institutes, but also by his local banker. The one saving fact with many a California vineyardist is that, owing to the influx of land seekers into our State, and because of the prosperous conditions of our dairy and live stock industry on alfalfa lands, the selling price of land has doubled in ten years, thus recouping some of the losses of the vineyard.

There is one striking feature of much of the small planting in our interior valleys, even on land that is fitted to grow diversified crops; there are too many one-crop tracts—one cannot call them farms. The settler is too apt, on the shallow advice of some glib real estate agent, to put all his eggs in one basket. He is told that this crop or that crop is going to net him a hundred or two hundred dollars an acre. This sounds very good, indeed, and he risks his all on a one-crop venture. Perhaps the whole neighborhood does the same and the evils incident to monoculture come to pass. The district may have but one main resource and if anything happens to that a blight falls on the whole community.

There is a special justification on the small orchard or vineyard for one or two or three acres of alfalfa instead of all fruit or grapes. The farmer's own family affords a home market, at full retail prices, for all the milk, butter, veal, pork, chickens and eggs raised on that acre or two. Allowing the prices that would have to be paid for these necessities, the indirect products of one acre of alfalfa may often be worth a hundred dollars for home consumption. The substitution of alfalfa for a fraction of the vineyard does not necessarily mean much permanent reduction in the tonnage of grapes shipped off the place, for the fertilizer produced will tend to increase or at least maintain the annual production of the vineyard.

Many thoughtful men are convinced that some reduction of the table grape acreage in sections where grapes are of medium or poor quality, ripening only during the six or eight weeks of glutted markets, is inevitable. Let us hope to see this reduction come about by degrees and in a rational way, and not as a panic of destruction, as may be possible, should one or two more disastrous seasons follow. In some instances growers are wisely planning to plant suitable fruit or nut trees, digging out every third vine, with the intention of eventually removing the remaining vines when the trees are old enough to bear.

Standardization.

Three seasons ago a movement of immense importance to our fruit and grape growers was initiated by a clear-visioned man, who perceived the all-important truth that, without some concerted movement to raise the standard of our grape and fruit shipments, our markets could not be maintained nor extended. Like all reforms, standardization has had its difficulties, but on the whole, as growers are becoming educated to its necessity, it is winning out and must eventually become widely established. The early shipments of table grapes of established standard this season, previous to the September rains, sold at handsome prices, fully justifying standardization.

Unfortunately in September, 1912, most of the grapes of California were soaked by a heavy rain. The interior berries of the more compact clusters were softened by the invasion of the botrytis, or slip-skin mould. It is very difficult for the packers to find and cull out all the berries injured by this fungus, as the color and texture is not always perceptibly affected. It was not always possible for the inspectors to determine which grapes would carry in good shape, and which would arrive with whiskers on them. As a result some thousands of cars failed to arrive in satisfactory condition. This has caused some criticism of standardization, but unjustly so. It may be years before the same thing will happen again.

In the mean time we shall hope that the United States Department of Agriculture will try to find some method of controlling this fungus in the vineyard. If an economical method of prevention can be worked out, it will be of immense value in improving the keeping qualities of our table grapes in seasons when early fall rains prevail.

In spite of the general softening of grapes, however, standardization barred out a great amount of manifestly poor stuff. Growers are better educated for next year. It was an important epoch in California's horticultural history when the thesis of standardization was nailed to the door of the packing-house by our far-sighted and courageous reformer and friend, the man who is helping solve some of our difficult economic problems—J. W. Jeffrey.

Spanish Table Grapes.

In the heavy importations of Almeria grapes from Spain there is both a menace and a hint for the future. Would it not be wise for the members of this convention to take action toward the continuance of the present tariff on Spanish grapes. They come into competition with our late season shipments of Tokays, Cornichon and Emperor. With the advent of a new tariff regime, should we not defend ourselves as best we can against the competition of the increased shipments which would result if the present tariff is lowered?

The Almeria grape is a type by itself, very different from any of our common varieties. It is as hard as an apple and of wonderful keeping qualities. In the warmer parts of this State it should do well. There is the possibility of a considerable industry in the growing of these for late markets, packed in crates, or for marketing in March and April, packed in sawdust or corkdust. In some localities it is a shy bearer; in other places, when properly pruned, it bears well. Experiments should be carried on to determine its adaptability to the different parts of California.

Freight Rates.

I shall not take up time with the discussion of this important matter, as I presume it will be handled by our able committee on transportation, the members of which deserve our heartfelt thanks for their unremitting efforts to secure fair treatment from the railroads.

Wine Grape Industry of the Interior.

The wine grape industry of the interior valleys differs greatly from that of the coast counties, where dry wines of high grade are produced from varieties of grapes planted for that specific purpose. Owing to the busy work of phylloxera for the past twenty years a large portion of the original plantings have been destroyed and partly replaced by plantings on resistant roots. Most of the recent plantings have been of desirable varieties suited to the making of fine grades of wine. The grade of dry wine made in the coast counties is so superior to the dry wine made in the interior that the grapes of the coast counties brought from twelve to nineteen dollars a ton this year, and for a term of ten years have averaged over twenty dollars a ton.

The wines of the interior valleys, most sweet fortified wines, are made largely from wine grapes, planted more for quantity than quality, and also to a large extent from surplus table grapes and raisin grapes. For instance, during the latter part of the season, there were daily about as many cars of table grapes sidetracked at the wineries of Stockton and Lodi as were being loaded for eastern shipment.

Cut off the markets for wines, by needless, careless or hostile legislation, and a heavy blow will be dealt both to the growers of table and of raisin grapes. The interests of the three classes of vineyardists are tied together; all three have suffered during the years since 1907. Since that year the average vineyard of the interior valleys has been run at a financial loss.

The actual cost of growing wine grapes in the interior on average land, including interest on the investment and taxes, is probably not less than twelve dollars a ton. At six dollars a ton, the prevalent price this season, there is a heavy loss. At the present time it is said that contracts are offered to vineyardists at ten dollars a ton for ten years. While it is unwise to give any one specific business advice, the grower, before coming to a decision, should remember that owing to constant increases in taxation, to increasing demands on the part of laborers, to the cost of employers' accident liability, and to the increased cost of living, that there may be no real profit in growing grapes at ten dollars a ton, but a loss. He should also distinguish between real contracts and alleged contracts, which are merely options, voidable at the buyer's pleasure. In any event he should hold himself free to dig out his vineyard and substitute some crop that will net a real profit, if he decides to do so. If his vineyard bears only average crops, he may do better to gradually reduce his vineyard acreage and work into alfalfa and other lines of production.

It is surprising to learn how few vineyardists keep any systematic record of costs of production. Most vineyards are planted in blocks of one or more acres. During the vintage the tonnage from each block should be kept track of. It is not uncommon for some blocks to produce two or three times as much as other blocks. The grower should know which blocks are not paying the expense of cultivation and operation and which ones are paying a profit. The modern dairyman goes to considerable pains to test his cows, so that he may eliminate those that cost more than they come to. The grape grower should know definitely whether a block of grapes is presenting him with an annual deficit or an annual profit. If there is a profit, he should decide if it is the best profit of which that land is capable, and whether he can make a better profit by substituting some other crop.

It seems as if one other matter should be considered. Within the next ten years, following the opening of the canal, we expect many thousands, perhaps a half million, southern Europeans to settle in California. In their own countries, wherever grapes are grown, these people are temperate users of claret and white wine at their meals, consuming an average of about a pint bottle a day, or not less than thirty gallons a year. If in California these people are permitted to maintain their old-country customs, the half million that are expected would make a home market for fifteen million gallons of wine a year. This would be enough to take care of any possible surplus and would put the grape industry on a secure and profitable basis for years to come.

Regardless of what measures may be taken to rid California of the low-class saloon, would it not be wise for our grape growers, and those of the community interested in the success of an industry representing an investment of over a hundred million dollars, to consider some amendment of the present local option laws. At the present time, under the Wylie bill, if a district votes dry there is nothing to prevent a man having a gallon of whiskey shipped to him by express and kept at his home or in his room at a hotel or boarding-house, but the hotel or boarding-house keeper is absolutely prevented from serving his guests with a temperate glass of white wine or claret at meals. To the southern European wine is the same as tea or coffee to the American. If the people of a community wish to close saloons but wish to give hotels and restaurants the privilege of serving light California wines with bona fide meals, why should not that community have the privilege of so deciding? I doubt if this matter was seriously and definitely considered when our legislators framed the present law. I am a believer in local option and the right of each community to regulate its own affairs as it sees fit. Perhaps the time will come when a great many communities in California will see fit to regulate affairs in the way thus suggested.

With the steady improvement in quality of our California wines the market for the better types is gradually broadening. The University of California recognizes the grape as one of the most important and has established a Department of Viticulture, ably headed by Professor Bioletti. An immense amount of valuable work has been accomplished. Among other investigations this department has recently demonstrated in a very striking and practical way, by actual work with commercial vintages, the great improvement that can be made in our California wines by the use of pure yeasts for the carrying on of fermentation.

California is unique in the importance and extent of its viticulture. Farmers and settlers from other states usually know nothing at all about grape growing. The work and advice of the viticultural department of the University, through its bulletins, through farmers' institutes, and through the press, is of great importance to the whole community. The legislature makes a biennial appropriation for special research in viticulture, but the amount is inadequate and should be increased.

One other topic, and I am through. The history of gluts and periods of overproduction show that in many cases they could have been prevented. It did not take a fortune teller to point out, after the planting of wine and table grapes had become an epidemic in 1901, 1902 and 1903, that overproduction of sweet wines was certain to follow. In 1903 Percy T. Morgan, president of the California Wine Association, in a clear and able paper read before the Fruit Growers' Convention in this very town of Fresno, told us all just about what was going to happen. Who heeded his warning? Very few.

For four years after his note of warning prices remained high. Farmers and speculators kept on planting, ignoring the fact that seventy thousand acres of young grapevines were quietly getting ready to suddenly pour a flood of crops on the unprepared market. If the same facts that were presented by Mr. Morgan to one fruit growers' convention in a ten-minute paper could have been put before the farmers at all the farmers' institutes held in the interior valleys for a year or two, by an agricultural economist from the University of California or elsewhere, probably the lesson would have been understood and much unwise planting and losses of millions of dollars been averted.

Most of our farmers are newcomers, not accustomed to studying the economics of horticulture and viticulture. Such knowledge must come to them through farmers' institutes or through the able agricultural journals of California, or through their county horticultural commissioners, in so far as they may be men of sound economic ability; but we need some starting point where the economic problems of California's varied and intricate agriculture and horticulture may be investigated; where young men may be trained to study not only crop production but crop marketing, not only tree planting but rational choice of varieties to plant.

The State Commission of Horticulture has made a good beginning in the collection of crop reports and horticultural statistics. This is useful and commendable; but unless by ample financial support the State Commission shall become a great deal more than a state bureau of entomology and quarantine; unless its work shall be broadened so as to help the growers solve their present and future economic problems, then we must look elsewhere. Perhaps, in any event, we should ask the University of California to begin by establishing a chair of agriculture and horticultural economics.

Already in California we have some thousands of fake "professors" of agricultural economics, who work, not for a salary and not for their health, but for the commission of five per cent or more on the land they sell. The new settler gets much of his agricultural and horticultural dope from these optimistic gentlemen, sometimes at a dear price.

I always appreciate the optimism of Mr. Seagraves, the irrepressible colonization agent of the Santa Fe railroad. Last week he assured an audience of a hundred and forty thousand people, through the columns of the *Country Gentleman*, of the opportunity of their lifetime—

> "You can buy desirable farms with water in the San Joaquin Valley at from $125 to $150 an acre and these farms, properly cultivated and planted, will return to you as much as Mr. Casalegno received from his land.

> "Mr. Casalegno made big interest on $150,000 this year. Mr. Casalegno owns 120 acres of fruit at Oakdale. If his net profit was only 6 per cent it would mean $75 an acre, or 6 per cent on a valuation of $1,250 per acre."

I do not question the sincerity of the railroad gentleman, but through what process of divination has he found out that his invited settler is going to secure the same kind of land as Mr. Casalegno's at $150 an acre, adapted to the same fruits? How did Mr. Seagraves definitely ascertain that the prices for fruit will be the same when Mr. Settler's new orchard comes into bearing in 1920 as was paid for Mr. Casalegno's crop? Mr. Seagraves is the same optimistic gentleman who in 1908 was advising settlers that wine grapes were paying $125 an acre annually, only that pipe dream was announced through the *Saturday Evening Post,* to an audience of about 750,000.

The great problem of the near future in California is the assimilation and education of the hundreds of thousands of settlers who are beginning to pour into California. How shall they be informed of what California has to offer them in the way of opportunities so that they may undertake lines of work and of investment which shall prove best for them and best for the community?

Professor Bioletti is starting a careful investigation of economic facts and principles underlying viticulture. Does not the same necessity exist for each and every line of agricultural production in our great State?

We need a starting point. Should not that be the establishing at our State University of a chair of agricultural and horticultural economics? Dean Hunt comes to us with the ambition, the ability, and the backing to develop the College of Agriculture along broad lines of usefulness. Shall we not help him by telling him what we need most?

Chairman Cook. This carefully prepared and thoughtful address is now open for discussion.

Mr. Nutting. Do you happen to know of any experiments anywhere in growing alfalfa in vineyards for the purpose of cultivation and cover crops? It is an idea that I had in mind some years ago, particularly in reference to a man who used to be in Coachella Valley. The man I speak of is Mr. Phil. Bear of Redbanks, who has an orchard and vineyard a little way outside of Lemon Cove, I am told: he has some acres. do not know how much land he has. Well, I understand he planted alfalfa among his vines, which he has trellised up, and he used this alfalfa as cover crops and that he gets some phenomenal results—crop profit from his vineyard; that he turns his hogs into the vineyards and lets them feed on the alfalfa and so gets a profit from his grapes, fertilization from the hogs which live on the alfalfa he raises there. This, I think, is a worthy suggestion and study for us. Some years ago Professor Wickson, I believe, spoke of the idea of alfalfa for fertilization purposes for the grapes and he said he couldn't see why that idea couldn't be followed out reasonably and have both crops of alfalfa and grapes, but he didn't think of the crop of hogs then.

When I came to this State twenty-seven years ago I used to attend the fruit growers' conventions regularly, every one that came along, and to-day when I saw our old friend, Russ D. Stephens, come up with his old subject attacking the Southern Pacific, and Mr. Swett here with his address on grape growing, I felt like it was a representative fruit growers' convention in which I am privileged to take a little part. Aside from the use as cover crops, which a little experimenting in that line of growing alfalfa, where he has given fertilization to the ground lying between the grapes without extra cost, except the expense of cultivation, and adding considerably to his crop of grapes, he has besides a crop of hogs, if treated that way.

Also another part of the story is that he could get some phenomenal profits shipping east the crops of those vines, because now the eastern markets are supplied with the Almeria grape from Spain, and which we have had a good deal of trouble in getting a crop of in this country. It may be of interest to add what I have noticed in various trade reports; that there are from four hundred thousand to six hundred and fifty thousand barrels of Almeria grapes imported into New York every year. Here is an opportunity for a new industry in this country, if we can find out just how to do it.

Mr. Schmidt. We are experimenting with a few vines, about sixty or seventy, that we are going to train up in the Spanish style, the trellis system, that is seven feet high and then separating the branches. As I believe I stated to Mr. Swett this morning, these kinds we have are only a few years old and have all been grafted on resistant vines. They have done fairly well this year, considering the variety. Some few of the grapes over there (on the table) now show how they keep, how they do, in sawdust. This particular variety we handle is the better variety of the Almeria.

Mr. Swett. What time do they ripen?

Mr. Schmidt. In October, extending through the month, and they don't deteriorate very rapidly. We have them also in the northern part of the State, but not in sufficient quantity in the north to say much about it. We know that some vineyardists are troubled with some physiological trouble—the black spots appearing on them, and of which we know nothing.

Mr. Roeding. In regard to the Almeria grape, I want to say that nearly every one who has had any experience with the Almeria grape in California has found it rather an unsatisfactory grape to grow. This has been largely due to the fact that these grapes have spotted more or less and the vine has been subject to mildew. I have both Almeria grapes and another variety which bears a close resemblance to it in my experimental vineyards, called the Olivette de Vendemian, that I imported from France a number of years ago, and I think Mr. Schmidt will bear me out that, although the two grapes bear a very close resemblance to one another, there is a most remarkable difference in the quality of the fruit, and I do not wish to say here that this Olivette de Vendemian that I have is probably the genuine Almeria grape, but, nevertheless, it is very much superior grape to the Almeria, which has been so generally grown in California, and I think if the development of shipping grapes in sawdust in kegs containing them, and we find it advisable to use other grapes outside of the Imperial which is being so generally used now, that this new type of the Almeria, which is really in my opinion an improved Almeria, will no doubt displace the variety that has been generally grown in this State as the Almeria.

Before I sit down I want to make a few further remarks in reference to one subject which Mr. Swett touched upon in his paper, and that is in reference to this convention taking some action in recommending that some duty be placed on the imported Almeria grapes. I do not know myself whether there is any duty on the imported Almeria, but I do know that from the experience of last year and this year that there is a great chance of developing the shipment of grapes in kegs in redwood sawdust and that business should be guarded, and not allowed to be encroached upon. Mr. Nutting made the statement that the importation of Almeria grapes in cork dust packed in kegs was between four hundred thousand and six hundred thousand kegs, while natural conditions are from nine hundred thousand to one million kegs annually. The Imperial grape has been found a most desirable grape for shipment in this sawdust and there is no question but it will relieve much of the congestion which we labor under at the present time from grapes which are shipped in crates. This has well been exemplified this year by the very profitable returns which growers have been receiving from the Imperial grapes which they have shipped to the eastern market. Last year the shipment of grapes packed in kegs of sawdust was in the neighborhood of two cars. This year, on account of the most favorable comments which were made on these two cars of grapes packed in sawdust, the grapes going east packed in that way have amounted to twenty-five carloads, and from the experience that was gained last year it is quite evident that grapes packed in this sawdust will keep for at least three months from the date of shipment, so you see the season for the distribution and disposal of these grapes amounts to quite a long period.

Chairman Cook. The Committee on Resolutions will make a note of this matter mentioned by Mr. Roeding.

Mr. Schmidt. I wish, Mr. Roeding, you would tell us something about the currant.

Mr. Roeding. I think Mr. Schmidt is just as well able to make the remarks in reference to the currant as I am. It seems very strange, with the development of our recent industry, that the Zante currant has not been more generally planted. You are well aware that the name Zante currant has been applied to a grape, and is not a currant at all. The true name of the Zante currant is really black currant grape, which is grown generally in Greece. I have been interested for a number of years in the future of this currant for California, for the reason that even our housewives in this country where raisins are so generally grown will go out of their way to buy Zante currants in preference to our Thompson Seedless. They claim that there is a flavor in this grape which is not found in the Thompson Seedless and the Sultana, and I am inclined to believe that there is something in it. Of course, we have imported the Thompson Seedless and the Sultana, which are most generally grown here, and it seems strange, the conditions being so favorable for the production of these grapes, that the currant has not been more generally grown here. Last year I happened to be over at the experimental vineyard of the government station, and we picked all the Zante currant crop they had on their vines. There were not many currants, but sufficient to make an experiment in order to determine how these grapes were dried. They were placed on trays, exposed to the sun for a short time, and then the trays were stacked. Those who sampled the raisins afterwards, and there were among them men who were thoroughly familiar with the best quality of the imported Zante currants, did not hesitate to say that this Zante currant, as grown here, was fully equal to the imported article. The grape requires no processing of any kind. It can be picked earlier than any other variety of raisin crop which we have, and there is no question in my mind but there is a great future for this grape in the interior valleys of this State, and I hope the time will come when it will be more generally planted. The vines seem to be excellent bearers, something which has been doubted heretofore because the grapes have never been given a thorough trial until the last few years, so with that fact of their being good bearers, and with the additional fact in their favor of their earlier ripening, they can probably be picked in the early part of August, it gives a grand opportunity for introducing the variety and developing this branch of the raisin business, which has never been touched on in the State.

Mr. Nutting. I didn't quite understand, at the beginning of this discussion, whether the Zante grape was a black or a red grape.

Mr. Roeding. The Zante currant is a black grape, but there are two varieties—the black currant and the white; the black currant, however, is generally grown. I saw it in Greece eleven years ago, and the black currant is the one generally grown in the vineyards of Greece.

Mr. Nutting. I was surprised to hear, at a meeting where several raisin growers were present the other day, that the point was made that the United States Government was still maintaining that the Zante currant was a currant and not a small grape. Has that been finally settled to the satisfaction of the government, or is that ghost of the past coming up again?

Mr. Roeding. There is no quesion at all, but it is a question that will be brought up whenever the tariff comes before the Senate and the House of Representatives. That is the old excuse that is made, that the importers bring up every time that the growers argue for a duty on raisin grapes, and they invariably contend that the Zante currant is the product of a currant bush, and is not a grape. I happened to be before the Ways and Means Committee four years ago, when this very same subject came up, and every importer present did his best to convince the committee that the Zante currant was a currant and not a grape.

Mr. Nutting. Granting all that, is it not a fact that there are so-called Zante currants, grown and brought into this country, that are a product of a currant bush?

Mr. Roeding. Not that I know of. Zante currant is really a name that probably was acquired by trade usage extending over a great period of years, and, of course, it is really a misnomer.

Mr. Stabler. We grew the currant in Sutter County about ten years ago. We had about twenty acres planted, and we found that it ripens about two weeks earlier than the Thompson Seedless, which brings it in on about the tenth of August in Sutter County. As long ago as eight or ten years Senator Perkins sent to the growers for information, and sent it to Washington in order to convince the committee there that currants grew on grapevines and not on currant bushes.

Mr. Nutting. I know of a man in Placer County who has had about twelve acres of the red Zante currant for some time, and upon writing him some time ago, he wrote me that they were still growing as well as ever, and were a very profitable product, so there is one experiment where they are grown commercially in this State. It is at Lincoln that this small red grape or currant is grown, and I believe Mr. Schmidt has said something at some time about it at the experiment station.

Mr. Schmidt. I believe it is the red variety of the currant, although I believe some mention it as the white variety.

Chairman Cook. We will now listen to Mr. W. R. Nutting, on the topic of "Co-operation of American Raisin Growers."

CO-OPERATION OF AMERICAN RAISIN GROWERS.

By W. R. Nutting, Fresno, Cal.

When this topic was assigned to me by Dr. Cook of Sacramento under the title of "Co-operation of Raisin Growers," I felt like changing it to "New Methods of Co-operation." "Co-operation of Raisin Growers" has grown somewhat stale during the last thirty years and therefore is hardly distinctive enough for our new public exchange system. The growers have been trying to accomplish results by various methods known to the trade generally in the past, but their efforts have always failed sooner or later. Sometimes they managed to stay together for a year, or two or three years, but it seems to me that the principle at bottom of all the old co-operative methods on what we call the "sign-up plan" was at best fundamentally weak.

For illustration, if a hundred men here in this room promised to stand up along that wall for one year, it would be physically impossible for all of them to do it. It is just about as impossible for three thousand men to stand up for a year or term of years, financially. People die, people get sick, something happens or some of the members or their friends get into trouble. They may sign an agreement to stand by each other for a year or two or three years, but you never succeed in getting them all to stand together permanently.

It is impossible for our growers to organize by themselves alone, owing to local conditions and the difficulties they have met with. In the old organizations there was much dissatisfaction, with the result that some would drop out, leaving those in the association carrying a bigger load than they were able to carry.

Gradually we came to see that something different had to be done. We had to devise some new plan. In turning over in my mind the experience of other lines of business, it came to me by degrees that we ought to have a "California Raisin Exchange," on the grain, butter, corn and cotton exchange plan. The idea at the bottom of that plan is that any two people, buyer and seller, can come together at any time at a place, commonly called "The Exchange," or the "Board of Trade," and transact their business. The moment they come together on a price, that makes the market price for that instant, and a large number of people doing business through the day establish the market price for that day. They do not "sign up" anything. One simply sells and the other buys. Examining the practical working of that system, we find that all over the world, from the Board of Trade at Chicago, the Cotton Exchange at New York to the Tea Exchange at Bombay, India, such exchanges are established, and also become centers for collecting and publishing information. They become, so to speak, crop report bureaus, and either the members exclusively, or the general public, receive all the information possible to collect; and so it is to be with our Raisin Exchange. All the information we can collect is to be distributed broadcast, that our raisin growers may know what is going on all over the world. Then they can keep themselves informed and up-to-date in all particulars. By looking in the morning daily papers they will see the transactions of the day before, the buying and selling, the highest price, the lowest price, the average, and the total sales.

We are anxious to have our own raisin trade paper, and the exchange proposes to start one as soon as possible, to start it right. We need a trade paper besides the daily papers, to give the growers throughout this country accurate and full information. The way things are now it is impossible to get accurate ideas of prices. We will gather up all the crop news, weather information in foreign countries, prices, and all that, and the grower will then have this information in a concise, readable form, as quick as it can be got to him.

There are reported to be in the United States from three to five thousand wholesale grocery jobbing houses. One in Chicago employs a hundred and forty-five traveling salesmen; another in New York has about two hundred. There are several thousand traveling grocery salesmen on the road every day, carrying around and giving out all information that comes to them regarding the products they deal in. To have Associated Press dispatches in all the daily papers throughout the country, so that all traveling salesmen, representatives of every jobbing house in the country, calling on a hundred and fifty thousand retail and wholesale grocery stores, can, with their breakfast, have in their morning paper a report of what was done here in raisins and dried fruit the day before, would be of immense value to our raisin and dried fruit industries. Everybody would be interested and watching the paper to see the latest developments.

We are very enthusiastic over this raisin exchange proposition. As stated before, it requires no signing up, and only a membership fee of ten dollars to join. We firmly believe we can accomplish all we have set out to do by using the different methods previously employed by various exchanges and other organizations throughout the country, which they have used so successfully. We are trying to bring the growers and business men together, and to get them on some footing where they will understand each other and work together. Most business men in this State haven't yet awakened to the fact that, by organization of fruit growers, they, themselves, as merchants, could get better prices and put their business on a sounder basis.

The object of both our exchange and our million-dollar company is to cause a steady, regular price, so that raisins cannot go below a certain price fair to the growers. The way things are now, the growers, with their expenses in raising and marketing their products, are not making enough to pay living expenses, and many are rooting out their vines and planting the land to alfalfa, which insures them quick cash and a good profit, while raisins do not. This exchange is to be a place where raisins can be bought and sold at auction, something the way corn and cotton, also grain and other similar products, are sold. To operate such an exchange here, and control it for the benefit of the fruit industry, the raisin industry, would benefit the whole community, but it is necessary to keep the control of it in the hands of the growers or their friends until the business is firmly established and confidence is established.

It has been stated that every dollar the grower deposits in bank is checked against *five times* before it goes out. That is to say, each dollar that the grower makes by the increased raise of prices for his goods, makes five profits for five different concerns before it leaves the country and goes off East. It is, therefore, for the great benefit of all business men to help the growers.

Professor Bioletti was right this morning when he said that at present prices the raisin grower had better give away his vineyard and work for the man he gave it to. But this can all be avoided if you will organize, standardize, and put the industry on a solid basis. Vineyardists don't want to make immense profits—just enough to pay expenses and have a little over, and surely that is not too much to expect.

Dr. Powell told us last night about how the women of Italy carry their lemons and other products in huge baskets on their heads; that is, the women and children of those foreign countries do the work. Women and children here don't work in the fields as they do in Southern Europe, and crops can't be grown as cheap. They can live there for a few cents a day, eating black bread and cheese, and so can work for a very small wage. Here their mode of living soon changes, and they require more for their living expenses. There can be no comparison in cost prices between our conditions here and those abroad.

This raisin exchange of ours has been worked up very carefully by writing it up in the newspapers, something as a political campaign is conducted, full page advertisements appearing in the leading papers, and everything being done to attract the attention of the people. We have enlisted the aid of the best known men in the country, and have put all possible means to work to organize both the California Raisin Exchange and our million-dollar company. This last organization is to employ the same methods that the general business man of big corporations would; that a firm of publishers would use in working up a big sale of subscription books; or that advertising men of newspapers would in canvassing for advertising for their papers. We are working from a practical business standpoint, not from the old sign-up association standpoint.

We are working to get this big million-dollar company thoroughly organized and in working order before the great influx of immigrants will come pouring into our State when the Panama Canal is opened in 1915; and when that class of people reaches here they can be brought into the organization just as anybody else here is, by buying shares, as in any stock company.

We now have over six thousand raisin growers in this State—a large industry. There is now about a hundred and fifty thousand acres of raisin vineyards in the State. Take up your morning paper and turn to the financial news column. You can find quotations on alfalfa, fruits of all kinds, cotton, pork, and so on down the list; but where is there any mention of raisins? We need our own trade paper; we need to advertise; we need to wake up and get a modern, up-to-date standing. We must have uniform prices.

Our raisin exchange is now starting on its second year of organizing work. We now have 1,970 members enrolled, and the number is increasing all the time. The idea was new a year ago, and at first it was hard getting the growers to come in; they knew all the old methods and were tired, discouraged, and had no faith, but we have convinced them that this is an absolutely new idea, different from the old ways. We want to carry our list of members on up into the thousands, until we have every grower in this State interested. It requires no signing up to belong to this exchange, and only costs ten dollars to join.

We must obtain reliable and accurate information concerning all phases of the subject, number of acres of all kinds and varieties of grapes and fruits, and this we are doing, and are getting reliable statistics for the use of the growers. We now have maps of thirty townships, showing just where every orchard and every vineyard is, and a complete mailing list of all the growers and their telephone numbers. We intend to have men out on the road throughout the entire season, gathering reports from these districts as to the rain, the wind and frost, crop conditions, and, in fact, everything that will tend to affect the growers' prices. All this information and data is to be compiled and at the service of our members. A bureau of this sort can best be conducted through an exchange, by the aid of the local papers and the Associated Press dispatches to all the daily papers in the United States. Only large exchanges or boards of trade can obtain this sort of information, and such wide publicity cannot be obtained in any other way but through them, except at a tremendous cost.

As Mr. Dargitz said this morning about the dried fruit association, we must organize, we must stand together. Look at the almond growers; see what they have accomplished, and this by organizing and doing away with the speculative element. We feel here in the United States as a nation that we each like to have our own way, and so the growers feel as though each wants to be free to sell when we wish to. My aim and great desire is to consolidate these seven thousand growers into a million-dollar company for doing business financially, and into a raisin exchange for the actual exchange of raisins for cash and the collection and publication of information.

I thank you very much for your kind attention and interest.

MR. SWETT. Mr. Chairman, I have a resolution I would like to present at this time:

WHEREAS, The practice of shipping green and immature fruit from California to the eastern markets is an injury to the State at large, and often a financial loss to the growers themselves;

Resolved, That we, the California Fruit Growers' Association, at its forty-second semi-annual meeting in December, 1912, at Fresno, California, hereby endorse the efforts of the state administration to bring about a standardization of fruits, so that with inspection at both ends our products may reach the consumer in good edible condition.

MR. SHEPHERD. Mr. Chairman, I think that would be a very unjust resolution. That would lead the country to misconstrue just what is meant, and would work irreparable harm to the orange industry in California.

CHAIRMAN COOK. We will refer the resolution back to the Committee on Resolutions.

EVENING SESSION.

Dr. Cook presiding.

CHAIRMAN COOK. We will now have the pleasure of listening to a stereopticon lecture on California's Viticultural Industry by H. F. Stoll, secretary Grape Growers' Association of California.

CALIFORNIA'S VITICULTURAL INDUSTRY: PAST, PRESENT, FUTURE.

By HORATIO F. STOLL, San Francisco, Cal.

One of the surprises of California, to the people who live outside the State, is the magnitude of our viticultural industry. Even Revenue Commissioner Royal E. Cabell, the governmental head of the service that has supervision of the wine industry throughout the country, was amazed at its extent when he first visited the Pacific Slope on a tour of inspection two years ago. "Of course," he said, "I had a general idea of the gallons produced, the number of tons of grapes used, and the various figures that come under my eye through the department, but figures can give no adequate idea of the scope of importance of the wine industry in this region. It needed seeing to grasp it fully."

Like Commissioner Cabell, many other people of the United States have heard much of the grape industry of the Golden West. They know that the State boasts of valuable crops that yield not only the "little wine for the stomach's sake," but the raisins that figure in a hundred different recipes and the huge bunches of grapes which ornament the tables of our leading hotels.

However, it is not until they have traveled through the greater part of our glorious State that visitors appreciate the fact that the growing of grapes in the United States and the industries based thereon are in a peculiar sense Californian. This State produces nearly all the raisins, three quarters of the wine and a large part of the shipping grapes. We are also beginning to specialize in the manufacture of grape juice, grape syrup and grape wine vinegar, and are utilizing the by-products of the winery in the manufacture of cream of tartar, tartaric acid and Rochelle salts.

According to the closest estimates obtainable there are upward of 300,000 acres in California devoted to grape cultivation. Of this acreage, over one half, or about 160,000 acres, is devoted to the growing of grapes used exclusively in the making of wine. About 90,000 acres are taken up with grapes intended for raisin purposes, but a large portion of these grapes, especially the second crop, are sent to distilleries for the purpose of brandy making, Muscat flavored brandy being consumed more largely than any other kind in the United States. A portion also of the first crop Muscat grapes is made into a wine called "Sweet Muscat," and also into fortified material for the making of sherry. About 50,000 acres are devoted to table grapes, the greater part of which is packed in crates and shipped to the eastern markets of the United States.

Investment.

The total investment in the grape growing industry of California, including vineyards and establishments for wine making and storage, grape drying and shipping, is estimated at about $150,000,000, from which a gross yearly income of nearly $27,000,000 is derived.

Table Grapes.

The market for our table grapes is constantly increasing. It is estimated that this year the shipment of table grapes nearly reached the 6,500 carload mark, and sold for about $6,000,000. It is safe to say that over one half of this production came from Sacramento and San Joaquin counties, which, with other sections of these two great valleys and southern California, are the home of desirable table varieties that find a ready sale in the eastern market.

California Raisins.

Next to the citrus fruits, raisins are the most important single fruit crop of the State. The commercial production of raisins in this State began in the eighties, and one of our great agricultural achievements was the capture of virtually the entire American market within less than twenty years and the production of more than one half of the Muscat raisins of the world. Formerly the best bunches were selected and sold in boxes, and the others were stemmed and graded according to size and sold as "loose" or "off stock," as "two-crown," "three-crown," or "four-crown," according to the size of the berry. Since the perfection of the seeding machinery, most of the raisins unfit for clusters are seeded and sold in cartons. The raisin industry is concentrated in a few districts. Tulare produces some excellent raisins, but probably four fifths of the crop is grown within twenty-five miles of Fresno, which is the great raisin center. Some raisins are produced in the south, notably in San Diego and San Bernardino counties, and large quantities of seedless raisins are produced in the lower Sacramento Valley, especially in Yolo County, which, indeed, long antedates Fresno County as a raisin district. Thirteen years ago, 71,567,000 pounds were produced in California. This year our output will reach about 170,000,000 pounds, and will be worth at least $6,000,000.

The Wine Industry.

But most important of all, from a financial standpoint, is our wine industry, which brings us in a yearly income of about $15,000,000. Last year our output was excessive, somewhere in the neighborhood of 50,000,000 gallons, but this year it is doubtful if the vintage exceeded 40,000,000 gallons. The dry wine output is conservatively estimated at 22,500,000 gallons, and the sweet wine production, according to figures furnished by the revenue office, will reach about 17,500,000 gallons.

As compared with the immense output of France and Italy this showing is small, but it must not be forgotten that it has taken those two European countries nearly 2,000 years to plant their extensive vineyards and create a world-wide market for their wines. Pliny, who is so rich in precious information on the agricultural and social advances of Italy, tells us that Italy opened her hills and plains to the triumphal entrance of the god Dionysius about 120 years B. C., and the cultivation of the grape has gone on uninterruptedly ever since. Every generation has poured forth new capital to enlarge its inheritance of vineyards.

Introduced by the Church.

The vine was introduced into France by the conquering Roman legions, and practically the same conditions as in Italy prevail there, only that a small area of the north of France does not produce grapes, while in Italy there is practically no section where grapes are not grown and wine made.

The viticultural industry of California, on the other hand, is really only half a century old, although the Franciscan Fathers planted the grapevine in California shortly after their arrival at San Diego in 1769. As the other missions were established, small tracts were planted close around their houses of worship. The padres guarded them jealously with high adobe walls, cultivated the vines carefully, gathered their fruit, and made wine, which was used in their religious ceremonies, or consumed by the good fathers, their occasional visitors, and their immediate retainers.

Even after the arrival of Americans in 1849, and with them representatives from every civilized nationality on the globe, but little advance was made toward increasing the area of viticulture until 1859, when, through the publication of vine articles in the reports of the State Agricultural Society, and in the newspapers, a general and widespread interest manifested itself in vine planting, and the area of our vineyards became very greatly increased. A very large proportion, however, of these new plantations consisted of table grape-producing vines, and the remainder were almost exclusively composed of the old Mission variety, which has now practically disappeared from California's vineyard land.

Fostered by Our Legislature.

In the early sixties, our state legislature sent a commission abroad to secure the finest varieties of grapes in Europe and Asia. This resulted in the planting of better varieties for the table, for the wine press, and for raisin curing; but it was not until about 1880 that the foreign varieties of grapes were set out extensively, for up to that time there were only a limited few who believed that any grapes could be as good as the old Mission variety, which produced an ordinary, coarse, heavy wine, taking an indefinite period to mature.

Through the persistent efforts of a few enterprising viticulturists, small quantities of wine were produced from imported varieties, whose character was so distinctive and so strikingly showed superiority over those made from the Mission, that new faith in the future of California wines was born, and the belief spread that under proper conditions our

State might some day make wine of a superior grade and eventually rival some of the better wines of European countries.

After fifty years of patient, costly, experimental work, and the expenditure of vast sums in repairing the ravages of the phylloxera and Anaheim disease, the great goal has been reached and to-day California wines are considered the equal of those produced in any section of the world. Even abroad they admit this, for at the International Exposition at Turin, Italy, last fall, a new brand of California champagne received the "Grand Prix," the highest award which the exacting jury could confer.

While conditions have been discouraging to the wine grape grower during the past few years, there is no question but that the industry will eventually be put on a stable foundation and then, instead of pulling up vines, a vast new acreage will cover our idle hillsides and other lands that are practically fitted for nothing else. In fact, as soon as the demand will justify, there is no reason why we cannot plant hundreds of thousands, yes, even millions of additional acres in grapes.

Future Possibilities.

God Almighty has been good to California in giving us a variety of favorable climates and an equal variety of good soils. In the coast counties and those contiguous to the bay of San Francisco, where the wine grapes mature at a high acid point and a low sugar point, we have a dry wine section that cannot be surpassed anywhere. There flourish the grapes that produce types analagous to the Claret, Cabernet, Burgundy, Sauterne, Chablis and Riesling wines. In our hot interior valleys, where the grapes, on the other hand, mature at a high sugar point and a low acid point, are to be found those varieties that make our Port, Sherry, Madeira, Angelica, and other sweet wines.

In fact, there is very little of the arable lands of California from the Vina vineyard of Stanford University, in Tehama County, on the north, to the Escondido Valley, in San Diego County, on the south, that is not capable of producing abundant crops of good grapes. Most of the states of the Union, Canada and Mexico can grow a limited variety of grapes in more or less limited quantities, but no region in the whole of North America can hope to compare with California successfully in the quantity, quality, and variety of her wine, table and raisin grapes.

The Labor Problem.

One of the most serious difficulties which we must overcome, if we hope to compete successfully with France, Italy, Germany, and Spain and Portugal in the wine market of the world, is the labor problem. This fall, pickers were at a premium in the vineyards, and, as a result, prohibitive prices had to be paid to the Japs, Hindoos and other available help that could be pressed into service.

But with the opening of the Panama Canal, it is expected that the influx of immigration from Southern Europe will help to adjust this vexing problem. According to Guy B. Barnham, who recently returned to Los Angeles after a tour of Italy, France and other points on the continent, a great colonization movement, with the fertile fruit and grape lands of California as the objective point, will start from France and Italy immediately after the opening of the Panama Canal.

While touring through Europe, Mr. Barnham paid particular attention to the conditions surrounding the fruit and wine industry in France and Italy, and learned that the middle class of fruit and wine growers are looking forward to California as the promised land, where all of their troubles will be over and where they will have, instead of a paltry one or two acres of vineyard or orchard, a fruit or grape ranch of fifty or several hundred acres.

Valuable Immigrants Coming.

"One of the most significant factors pointing to a systematic establishment of Italian and French vineyard colonies in California," said Dr. Barnham, "was my conversation with William S. Dalliba, manager of the Paris branch of the American Express Company, whom I met in Paris. Mr. Dalliba, who is a personal friend of James Stillman, of New York, told me of a conversation he had with Mr. Stillman a week prior to our meeting. Mr. Stillman, who represents the Morgan-Harriman investment syndicate, had been in California for two months incognito, and had been looking over the situation thoroughly with the end in view of investment in lands. Mr. Stillman stated that he looked forward to one of the greatest movements of the small vineyardists and laborers of France and Italy in seeking lands in California that has ever occurred.

"With the completion of the canal there will be a water journey possible from France or Italy to California, which is vastly cheaper than the present transportation by ship and then by rail across 3,000 miles of continent. This will appeal to the worker in the vineyard. The success of the Italian and French winemakers and growers in California has reached the ears of their hard-working countrymen back home, and they are waiting and saving money against the time when the great canal is opened, and they will be able to sail from their own home direct to California.

"These thrifty vineyardists and fruit growers must not be confused with the ordinary immigrant who lands in New York and stays there. They are sons of the soil, and are perhaps the most skilled farmers in the world, for they are able to wrest a living from an acre of ground for several families. They watch the soil as a woman does her rising bread."

Such immigrants are very desirable to California, since they will not remain in our cities, but will immediately hie themselves to the farm and ranch lands, where they will become producers of wealth.

Advising the Stranger.

It is to be hoped that by 1915 California will have secured a state immigration bureau, not so much for the purpose of inducing people to come to the State as to encourage the right kind of people to come, and to distribute them wisely throughout our grape sections when they arrive. Such a bureau, which would make it possible for a stranger in a strange land to learn from a reliable source and in his own language the opportunities and demands of the different grape sections of the State, is indispensable to his success and that of our wine industry.

Of course, they will be able to secure valuable information and co-operation from the University of California, which, by the way, is the only state educational institution in the United States that has a department of viticulture that attempts to teach practical grape growing and wine making. Prof. Frederic T. Bioletti is in charge of this department and his advice is always of great value to any stranger, for he has the information at his finger tips and is familiar with every vineyard section in the State.

Experimental Stations.

Another source from which the stranger will be able to secure accurate and valuable information is the Department of Agriculture, which has a dozen viticultural experiment stations in California, in charge of Prof. Geo. C. Hussman.

The three most important of these stations are located at Oakville, in Napa County; at Guasti, in San Bernardino County; and near Fresno. They have developed into places of broad viticultural research and experimental work, and furnish practical object lessons in viticulture and an excellent opportunity to solve many problems of commercial interest.

Among the prominent problems which have been occupying the attention of Professor Hussman at these experimental stations are comparative tests of the resistent stock varieties, congeniality determinations between Vinifera and different resistent varieties, studies on determination of varieties best adapted to different localities, testing the classes of grapes with reference to their resistance of insects, diseases, etc.

In a conversation with Professor Hussman a few days ago, I was informed that, when the vintage arrives next fall, he proposes to invite the grape growers in the vicinity of these three stations to a series of talks which he will give in the experimental vineyards, explaining, with the aid of his assistants, exactly what has been accomplished with the different varieties of grapes by the government, after years of careful experimental work.

Professor Hussman, by the way, deplores the lack of interest taken in this work by the average grape grower. He expresses the hope that, even though his talks next fall will take place during the busy vintage season, the grape growers will feel justified in dropping their work for a day and visit the stations, which show up to best advantage when the countless varieties of wine, table and raisin grapes are ripe and ready to be picked.

A 1915 Grape Day.

During the exposition year efforts should be made to provide ways and means by which the hundreds of thousands of visitors to California will have an opportunity to inspect our important vineyard sections. Excursions should be arranged, especially during the vintage season.

Merely to exhibit at the exposition will not do, because the displays of the products of our vineyards and wineries will be only a small item among the millions of interesting things that will be shown in the various palaces.

Of course, all the sightseers will not be able to tour the State, and, therefore, to impress the greatest number with the importance of our industry, I believe it would be a good idea if our table, raisin and wine grape growers would get together and formulate plans for a spectacular "Grape Day." I have talked over the matter with President C. C. Moore, of the exposition, and he is enthusiastic over such a picturesque celebration. He has promised to give the event world-wide publicity by including it in the official programme, which will be sent to the four corners of the globe at least a year before the exposition opens.

For this event we should select a day when we may be sure of a record attendance; that is, the day before or after some especially big event early in September. This will enable our winemakers and grape growers to take an active part in making the day a huge success, and will occur at a time when there are plenty of table grapes on hand to make a good showing.

The programme could consist of a street parade, made up of floats from every table. raisin and wine grape growing county in the State, literary exercises on the grounds in the afternoon, and a grand banquet and ball in the California building in the evening.

This would permit each of the divisions of the industry—the table, raisin and wine grape growers—to celebrate in their own way, and would advertise our viticultural interests as they have never been advertised before, especially if it were announced that hundreds of thousands of cartons of raisins, and tons and tons of grapes were to be distributed free.

Distributing Fruit to Visitors.

In this connection I would suggest that the fruit and raisins that are to be given away be purchased, if necessary, so that when our Grape Day arrives there will be no hitch as to the amount that will be available. If the committee in charge depends upon voluntary contributions from the different firms and growers, they are likely to find themselves disappointed.

Carloads of fruit were promised for California Day at the Alaska-Yukon Exposition at Seattle, and accordingly the papers were informed weeks ahead that large quantities of choice California oranges, apples and grapes were to be given away to the public. But when Admission Day came, which was called "California Day," it was found that most of the promised fruit did not materialize, and it was necessary, therefore, in order to keep faith with the public, to go to the Seattle markets and buy enough California fruit to make up the deficit.

It was announced that on Children's Day two thousand cartons of Fresno raisins were to be given to the little ones in the afternoon. When the cases were rolled out in front of the California Building a dense crowd of struggling children surrounded the men who were opening the boxes and passing out the cartons. The jam was so great that the little ones were almost smothered by the more aggressive tots anxious to get a box of raisins. Those near the distributors couldn't budge one way or another, being hemmed in by those on the outside, who were shoving and pushing to get nearer. The fortunate ones near the boxes kept reaching for more until some of them had grabbed half a dozen cartons.

Colonel Wiggins, who viewed the scene from the top of the stairs, called a halt and ordered the boxes taken to the rear of the building, where a row of rustic benches were placed parallel to the back of the wall. The children were compelled to file through this passage one by one, and the plan worked beautifully.

I regret to say, however, that it had an unhappy ending for some of the children at the end of the line, who were repeatedly asked to stop shoving and go slow, as there was enough for every one. In a seemingly endless procession they filed past, some of them a second time, until the supply ran out, with a line still unsupplied containing some hundred children.

Apples had to be substituted for raisins. Some were glad to get them, while the mothers of others, showing an unpleasant phase of the much-vaunted "Seattle spirit," declared it was a shame, after they had been so patient, that their little ones were cheated out of a package of raisins, which goes to show that if we attempt a Grape Day we should do it right and live up to every announcement made. We want every one to have a bunch of grapes or a carton of raisins, so that they will go away happy and thoroughly impressed with the importance of our viticultural industry.

CHAIRMAN COOK. The meeting is now in order. What will be the first?

MR. ESSIG. Yesterday a resolution was presented to the house, calling for a commission to be appointed to consider intercounty quarantine. In order to avoid, as far as possible, the passing of quarantine ordinances which are considered by nurserymen and county commissioners and fruit growers to be a hindrance to the possible development of their business, I make a motion that we now nominate two members of this convention as members of this commission, and if it is in order, Mr. Chairman, I would like to make the nomination—

MR. CHAIRMAN. No objection whatever.

MR. ESSIG. I would like to nominate Mr. E. N. Richmond of San Jose as one of the members of that commission, as I believe he is a man who is energetic and keenly interested in this question, and that he will attend the meetings and will prove valuable in his aid and help.

MR. VAILE. And I would like, if it is possible, right now to make the nomination for the second man of these two. I would like to name as the second man of these two, one of the men who is the most responsible for the fruit industry than possibly any other man of the State, or possibly in the world, for that matter—a man of ability, knowledge and influence; I name as the second man of these two members of this commission, Mr. G. Harold Powell.

CHAIRMAN COOK. We will act upon this first nomination of Mr. E. N. Richmond of San Jose as one of the members from the growers. Anybody second the nomination?

A MEMBER. I second the nomination.

CHAIRMAN COOK. The motion is made and seconded that Mr. E. N. Richmond be appointed as a member of this commission. I am sure that all who heard Mr. Richmond's very fine address will appreciate that there had been no mistake made in nominating him, as he is a very valuable man in this work. Any remarks upon this nomination? All in favor of Mr. Richmond's nomination say aye.

The motion is unanimously carried. Mr. Richmond is one of the members of this commission.

Will any one second the motion of nominating Mr. G. Harold Powell as the other member of this commission? Mr. Powell is at the head of the California Fruit Exchange, is widely known and very influential and just the man we want. Who will second his nomination?

A MEMBER. I second the nomination.

CHAIRMAN COOK. All in favor of Mr. Powell acting on this commission say aye. The motion is unanimously carried.

Any other business to come now before the meeting? We will now have the remaining resolutions.

The 1915 Meeting and the Panama-Pacific Exposition.

Be it resolved by the California fruit growers in convention assembled in Fresno, December 11-13, 1912, That we thank Director Moore for his invitation that the State convention for 1915 be held in the Convention Hall of the Panama-Pacific Exposition in San Francisco; and that we give to that great enterprise our hearty and material support, with the end in view that California tell the story to the world of her great and diverse resources in horticulture and pomology.

Crop Reports.

WHEREAS, The careful crop reports on fruits gathered monthly by Chief Deputy Merrill have proved of great assistance and value to our fruit growers,

Resolved, That we commend and thank State Commissioner A. J. Cook for having initiated this important progressive measure; appreciating its value, we request its continuance and the extension of its scope to include such field crops as potatoes, onions and beans.

College of Agriculture.

WHEREAS, The University of California will ask the legislature for increased appropriations to extend and enlarge the educational and research work and its public relations to the State; and

WHEREAS, The University of California is planning to develop a College of Agriculture of the most far-reaching value to the agricultural interests of the State; therefore, be it

Resolved, That the State Fruit Growers' Convention strongly approve the policy of the university in endeavoring to enlarge its usefulness to the agriculture of the State; that this convention endorse the movement as a wise public policy, and that this convention express its approval to the Governor, the Senators and Assemblymen, and urge them to appropriate sufficient funds to meet the needs of the College of Agriculture, as outlined by the university, to the State Board of Control and to the State Legislature.

Resolved, That a copy of these resolutions be sent to the Governor, and to each State Senator and Assemblyman.

College of Agriculture.

WHEREAS, The business and economic factors of agriculture and horticulture are fully as important as the technical and scientific factors; and

WHEREAS, In our rapidly developing State of California our present and future settlers need education and guidance along economic lines; and

WHEREAS, The work of the College of Agriculture in the past has to some extent been confined to scientific and technical work;

Resolved, That this Forty-second Convention of Fruit Growers urge upon Dean Hunt, upon President Wheeler, and the Board of Regents, the advisability of establishing a chair of agriculture and horticultural economics.

Shipping Green Fruit.

WHEREAS, The practice of shipping green and immature fruit from California to the eastern markets is an injury to the State at large, and often a financial loss to the growers themselves;

Resolved, That we, the California Fruit Growers' Association at its forty-second semi-annual meeting in December, 1912, at Fresno, California, hereby endorse the efforts of the State administration to bring about a standardization of fruits, so that with inspection at both ends our products may reach the consumer in good, edible condition.

Thanks to State Commissioner of Horticulture.

WHEREAS, The Forty-second Fruit Growers' Convention, held at Fresno, December 11-12, 1912, has proven of unusual interest and value to our fruit growers;

Resolved, That we extend to State Commissioner A. J. Cook our appreciation for his wise selection of topics and his able management of the convention.

MINUTES OF ANNUAL MEETING OF STATE ASSOCIATION OF COUNTY HORTICULTURAL COMMISSIONERS.

Fresno, Cal., December 10, 1913.

The annual meeting of the State Association of County Horticultural Commissioners was called to order at 9.15 a.m. at the Hughes Hotel, Fresno, Roy K. Bishop, President of the Association, presiding, and H. P. Stabler, Secretary. Thirteen county commissioners were present. Wm. Wood, Commissioner of Los Angeles County, was absent, but a letter from him expressing his regret at being unable to attend was read by the secretary. R. S. Vaile, commissioner of Ventura county, addressed the meeting on the mealy bug. This address was considered of such value to the commissioners that Mr. Vaile was requested to write out his remarks and the address was published in the Fresno *Republican* December 11th.

The discussion of Mr. Vaile's remarks on the mealy bug resolved itself into a general discussion of fumigation. Dr. Cook, State Horticultural Commissioner, was present, and took part in the discussion on mealy bug and fumigation. Dr. Cook addressed the commissioners on the "Relation of County Commissioners to Nurserymen." He said the question was a delicate one, and he did not want to upset the present system. He advised the commissioners to get together with the nurserymen, and said that we could not help by constantly changing the laws. After radical changes in the laws several years may elapse before we could be able to accomplish as much as under the present laws. He advised co-operation with the nurserymen in endeavoring to eradicate pests, and said: "Do not offend nurserymen and do not antagonize them." The Doctor said that he would call the commissioners at the summer fruit growers' convention. He then spoke of the quarantine against the alfalfa weevil, and said that it should extend to nursery stock from infested districts, unless the stock was shipped without hay or tule packing. He spoke of the necessity of quarantining against the importation of hives of bees on account of the danger of introducing the alfalfa weevil. He said the statement made at the recent nurserymen's convention at Oakland, that the county ordinances were not constitutional, was not true, but that county commissioners cannot condemn nursery stock unless they find the stock infested. In the opinion of Dr. Cook the present quarantine against all nursery stock from the gulf states should be modified to cover only host plants of the *Aleyrodes citri* and *A. nubifera*. All stock from the quarantined states should be defoliated and fumigated on arrival in California. The State Commissioner asked the association to appoint Mr. Hecke, Mr. Cundiff and Mr. Marchbank a committee to confer with the State Commissioner on matters pertaining to inspection and quarantine.

Fresno, December 10, 1912.

At 2 o'clock p.m., the association was called to order by President Bishop. Dr. Cook read quarantine orders Nos. 17 and 18, after which a general discussion took place on the advisability of modifying the quarantine in accordance with the views expressed at the morning session. The commissioners generally agreed with Dr. Cook regarding the proposed modification of the orders. Dr. Cook read an opinion by the Attorney General on the laws under which the county commissioners were working. On motion the Doctor was requested to mail a copy of the opinion to each of the county commissioners of the State. The fact that several counties have no county commission was presented to Dr. Cook, and he was asked to urge the fruit growers in those counties to proceed to have the county horticultural commissioner appointed in those counties. A general discussion here ensued on the work of the county horticultural commissioners and was participated in by all the commissioners present. Mr. Wilsie spoke on the cotton industry in Imperial Valley. Mr. Vaile spoke of his work in Ventura County, with special reference to his experiments in the control of pests, morning-glory, and the green spot of the lemon. Mr. Beers spoke of the valuable work of Dr. Lipman in Santa Barbara County in soil investigations. He said Professor Fawcett had also assisted him very much in his work. The advantage of the use of the King soil tester was referred to.

At 4.30 p.m. recess was taken till 7.30 p.m.

The association met at 8 o'clock at the Hughes Hotel. Twenty-six county horticultural commissioners were present.

Dr. Aaronsohn, of the Jewish Agricultural Experiment Station, Haifa, Palestine, was called to address the meeting. His remarks were particularly interesting and were listened to with rapt attention.

The subject of the uniform inspection certificate was taken up and discussed. A copy of the certificate as used in Sutter County was exhibited, and its advantages explained to the convention. Mr. Pease favored the adoption of a uniform inspection certificate, and said if nursery stock is carefully inspected the certificate should so state. Mr. Cundiff uses the same certificate as the one exhibited, but sends it to the shipper. He also attaches a tag certificate to each shipment. Mr. Vaile said that the county commissioners should act together more closely and should notify each other of rejected shipments. He thought the Sutter County certificate could be placed on the tag for attaching to shipments. Mr. B. R. Jones thought that the certificate should be sent to county commissioners at destination and not to consignee. Dr. Cook said Oregon nurserymen were making large shipments to California this season. Mr. Vaile moved that the Executive Committee and the State Commissioner be requested to draw a form of certificate, to be printed at State expense, and its use urged on all county commissioners. After some debate the motion was tabled. Mr. Hickman thought the commissioners should be careful in the use of certificates and that certificates should always mean just what they say. Messrs. Beers, Cundiff and Garden spoke on the question and favored the uniformity in certificates.

On motion of Mr. Cundiff the whole matter was laid on the table and at 10.15 p.m. adjournment was taken to 8 p.m., December 11th.

FRESNO, December 11, 1912.

The association met at 8.25 p.m. at the City Hall, Fresno, Roy K. Bishop presiding. Prof. C. W. Woodworth, of Berkeley, read a paper on "Our Horticultural Inspection Laws." No discussion took place on the paper. The meeting adjourned at 10.30 p.m. to 7 p.m. December 12th.

FRESNO, December 12, 1912.

The association was called to order at 7 p.m. by Roy K. Bishop, president. Thirty-one county commissioners and many nurserymen and fruit growers were present.

Mr. P. A. Dix, a nurseryman of Ogden, Utah, was present, and addressed the meeting on the advisability of modifying the quarantine order against the introduction of the alfalfa weevil. He said no alfalfa weevil existed in the immediate vicinity of his nursery, and he believed that nursery stock packed in "shingle toe" direct from the lumber mills of Oregon and shipped in tight boxes could be sent to California without any possibility of introducing the alfalfa weevil.

Dr. Cook said the fruit interests of California must be protected and no injustice done to nurserymen. There is great danger of receiving alfalfa weevil if nursery stock is packed in tule or straw. Stock must be packed in clean boxes and thoroughly inspected on arrival in California. He quoted Dr. Titus as saying no danger existed if stock is packed in clean boxes. A general discussion on the alfalfa weevil then took place. At this time a recess was taken and the State fruit growers' convention was called to order.

9.30 p.m.

The association was again called to order by Roy K. Bishop, president. Prof. J. B. Corcoran, of the Fresno High School, spoke on "Agriculture in the High School." After Professor Corcoran's talk, a resolution was adopted requesting the Resolutions Committee to act on his paper.

The discussion on alfalfa weevil quarantine was then resumed. In answer to a question by Mr. Jones, Dr. Cook said the alfalfa weevil, if imported into the State on nursery stock, would come in in the imago or adult form. Mr. Vaile said any action taken by this body would necessarily be only advisory, and moved that it be the sense of this meeting that we advise the State Commissioner of Horticulture to suggest to the Governor a quarantine order prohibiting the importation of any nursery stock from Utah, Wyoming and Idaho unless each shipment is fumigated and packed in shingle toe, and fumigated again at the point of destination. The motion prevailed.

Mr. G. E. Merrill, Deputy State Commissioner of Horticulture, was asked to address the meeting on the danger of importing alfalfa weevil in California. He said he spent ten days in Utah and published the facts as he saw them in the Monthly Bulletin of the State Commission of Horticulture. There is less danger of the importation of the weevil in nursery stock than there is in importing bee hives, but there is danger, of course, of importing the weevil in nursery stock.

Dr. Cook. The greatest endeavor will be made to patrol the railroad tracks in California the coming season in order to discover, if possible, any outbreak of the alfalfa weevil. He said both Dr. Titus of Utah and Mr. Smith of the Department of Agriculture held that there was danger of importing the weevil in nursery stock. Mr. P. A. Dix said that Dr. Titus had told him there was no danger of importing the weevil if the nursery stock was packed in clean, new boxes and shingle toe instead of tule or hay was used.

A report was received from the Executive Committee recommending that the stub form of inspection certificate, in addition to the present tag system, be adopted, and the certificate be mailed to the commissioner in the county of destination. Also, that a Legislative Committee be appointed; also, that an annual membership fee of $2.50 be levied.

The report of the Executive Committee was adopted.

Mr. Gallaway moved that the Legislative Committee be appointed by the chair, and the motion was adopted.

On motion of Mr. Mills, the association proceeded to the election of officers. Nominations for president were declared in order. Mr. Beers nominated Mr. Vaile for president. Mr. Gallaway nominated Mr. Beers, who withdrew. Mr. Weeks nominated Mr. Cundiff, and on motion of Mr. Banks, the nominations were declared closed. The chair appointed Mr. Mills and Mr. Marchbank tellers. Twenty-six votes were cast. of which Mr. Cundiff received 19 and Mr. Vaile 7. Mr. Cundiff was thereupon declared duly elected president. Mr. Cundiff was called, and thanked the association for the honor conferred. Mr. Beers nominated Mr. Vaile for vice-president, and he was elected by acclamation. Mr. Vaile also made an address. Mr. William Garden of San Joaquin was elected secretary-treasurer by acclamation, and addressed the meeting, speaking particularly of the future welfare of the association.

On motion of Mr. Bloomer, Messrs. Hecke, Cundiff and Marchbank were appointed a committee to advise with Professor Cook. It was moved by Mr. Beers that the president be instructed to appoint two members to act with the Committee of Seven when occasion arises, as provided by resolution of the State Fruit Growers' Convention.

Mr. Mills moved that a committee of five be appointed to report at 12 o'clock noon, Friday, on constitution and by-laws for the association. The motion prevailed. and the chair appointed Messrs. Hickman, Beers, Jones, Vaile and Bloomer.

At 11.20 p.m. the meeting adjourned to meet at 12 o'clock noon, Friday, at the Hughes Hotel.

FRESNO, December 13, 1912.

The association was called to order at 1.20 p.m. at the Hughes Hotel, R. P. Cundiff, president, in the chair. In the absence of William Garden, secretary, H. P. Stabler was appointed secretary pro tem.

Mr. Hickman, chairman of the Committee on Constitution and By-Laws, read the report of the committee. After various amendments were discussed and adopted, the report was referred back to the committee with instructions to rearrange the report and submit it to the next session of the association.

At 2.20 p.m. recess was taken until 7 p.m. at room 3, Hughes Hotel.

FRESNO, December 13, 1912.

The Association of County Horticultural Commissioners was called to order at 7 p.m., room 3, Hughes Hotel.

R. P. Cundiff in the chair; William Garden, secretary. A large number of the county commissioners present. Dr. Cook, Chief Deputy G. E. Merrill, and E. O. Essig, secretary of the State office, also Mr. P. A. Dix, a nurseryman of Ogden, Utah, and Mr. Roeding of Fresno, J. W. Jeffrey, secretary of the Deciduous Fruit League, were present.

Chief Deputy Merrill presented a paper to the commissioners upon the value of the monthly report of last year, commended certain county commissioners for the promptness in which their crop reports were sent to the State office, others were requested to be more prompt in the future, as the State office is anxious to get the monthly report out on time, as there is great call for it, and they have been of great service to both growers and shippers in the past season.

Dr. Cook, State Commissioner, also spoke in support of Mr. Merrill's paper, and credited Mr. Merrill as being the author of the monthly report. Mr. Bishop expressed himself in favor of reporting important crops accurately (including all crops).

Mr. E. O. Essig desired to say a few words, before leaving for the fruit growers' convention, and expressed appreciation of the efforts of the county commissioners in supporting the State office and of the harmonious feeling which had pervaded all the sessions of the convention, and expressed great pleasure in being present at such meetings, and of the good that would result to all concerned.

Mr. Cundiff asked Mr. Essig regarding quarantine orders, and requested that all inspectors be supplied with same.

Discussion of Mr. Merrill's paper was again resumed. Mr. Merrill presented a chart, outlining the crops which he expects the commissioners to make monthly reports on the coming year, which included vegetables in great variety. Mr. Garden suggested that he add asparagus to the list; it also included alfalfa to be cut for hay, alfalfa for pasture, acreage of same, and the annual tonnage of hay cut. Mr. Garden contended that accurate estimates of the many crops mentioned in Mr. Merrill's paper would be very hard to get.

Mr. Pease objected to too many details, and stated that to comply with Mr. Merrill's paper would cause much added expense to the county, and in his opinion they already had all they could stand.

Mr. Jones of Los Angeles County, speaking of the reports turned in for the year just ended, said, in his belief, that the inspector's returns make the best estimate possible.

Mr. Bloomer of Sacramento County commenced two years ago to take census of the orchards, and found great errors in the assessors' reports, but now both are in harmony.

Mr. Cundiff stopped discussion on Mr. Merrill's paper.

Mr. Bishop called on Mr. Jeffrey, who took up the matter of marketing dried fruits, but gave warning that such associations be started correctly, that county commissioners can help to remedy present conditions, and cited the success of the orange growers' exchange. Mr. Jeffrey thought commissioners ought to take an interest in everything pertaining to the fruit grower, such as giving advice on soil conditions, tree planting, pruning, etc. To do all they could to better the conditions of the marketing of fruit; in other words, the commissioner should be the fruit grower's general adviser. Mr. Cundiff fully indorsed Mr. Jeffrey's remarks.

Mr. Dix of Utah then addressed the meeting on the fruit conditions of Utah. At present, Mr. Dix said, they had too many good peaches to market, and that they had formed a county association, and that a state association had been formed by the county associations.

Mr. Jeffrey's views were indorsed, as he clearly showed the advantages in marketing by the growers getting together. An interesting discussion then took place, led by Mr. Bloomer.

Mr. Roeding addressed the meeting, by invitation, and spoke very highly of the improved relations between the nurserymen and commissioners, and was very pleased with the resolutions passed by the convention, and stated that it was a great pleasure for him to attend such meetings, and very much good, he was satisfied, would result from the actions taken. He said nurserymen ask no favors from the commissioners. All they ask is a square deal, and he felt satisfied that they were going to get it.

Mr. Stabler was then called upon, and stated that he thought joint meetings with the nurserymen were most beneficial, and believed that improved relations will continue with the elimination of drastic ordinances without proper advisement. He stated that he appreciated the importance of good nurserymen, and it was the desire of the commissioners to protect both them and the growers, and stated that he had been present at many meetings that had been held in the last ten years, and that this was the best meeting ever held, and proposed resolutions to that effect.

It was moved, and seconded by Mr. Jones, that a vote of thanks be extended to the retiring officers. Motion carried.

Mr. Hickman's resolution was then presented. Mr. Stabler moved for adoption. Carried.

Resolved, That as the Horticultural Commissioners we feel that one of the best results of the present meeting is the creation of a harmonious sentiment between nurserymen and commissioners, who will not request the adoption of any new county ordinances, unless submitted to the referee board.

Mr. Stabler moved that "The Pacific States Nurserymen" be invited to meet with us at the next annual meeting. Carried.

Adjournment.

WM. GARDEN, Secretary.

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    vineyards, 483.
Yellow mite, 356, 359.
Zante currant, 502, 503.

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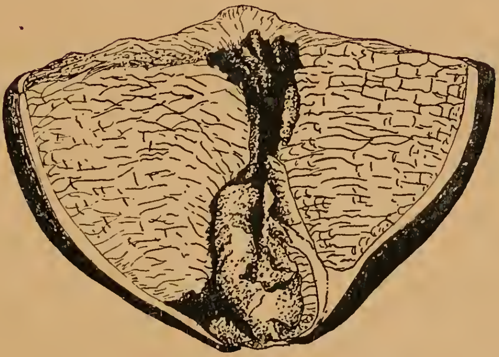

Cross section of orange showing course of the black rot from the navel to the center. (Drawing by Amundsen.)

OF

STATE COMMISSION OF HORTICULTURE

SACRAMENTO, CALIFORNIA MAY, 1913

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STATE COMMISSION OF HORTICULTURE

May, 1913

THE MONTHLY BULLETIN

VOLUME II — No. 5

DEVOTED TO THE DESCRIPTIONS, LIFE HABITS AND METHODS OF CONTROL OF INSECTS, FUNGOID DISEASES AND NOXIOUS WEEDS AND ANIMALS, ESPECIALLY IN THEIR RELATIONS TO AGRICULTURE AND HORTICULTURE.

LIB
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1913

BLACK ROT OF THE NAVEL ORANGE.[1]

(*Alternaria citri* Pierce and Ellis.)

BY EDW. O. AMUNDSEN.

Introduction.

Each year since the early nineties a percentage of the navel orange crop of the State of California has been affected by a black rot disease of the pulp cells, generally starting at the navel and extending more or less deeply into the tissues towards the heart of the fruit. This disease is known by all of the following names: "Black Rot of the Navel Orange," "Navel Rot of the Orange," and "Black Heart."

As it is a disease of the navel varieties almost exclusively, and was first described by Pierce under the name "Black Rot of the Navel Orange," that name has been used in this work.

This disease is so common that almost every person has been obliged at some time to cut away a larger or smaller part of an orange affected by it. This loss to the consumer represents a part of the total loss due to the ravages of the fungus and is, of course, impossible to estimate. Many oranges, in which the disease has developed considerably, fall from the tree early in the season. Others, infected later or in which there has been little development of the fungus, hang on the tree and on account of the very high color are readily seen and are prized for early eating. They mature earlier than the rest of the crop.

Compared with other diseases of the citrus fruits and trees, this is not of much economic importance. However, as the total value of an average crop of navel oranges of the state is enormous, even a very small percentage of that value represents a considerable sum. Also there is a possibility that the percentage of infection may run quite high if conditions favor the dissemination and propagation of the disease producing spores.

Previous Accounts of the Disease.

The first known account of this disease was written by Newton B. Pierce and appeared in the *Botanical Gazette*, 1902, pages 234-235, as follows:

"A fungous disease of the navel orange has attracted attention in the orange-growing districts of California for the past eight or ten years, and was named Black Rot by the writer on account of the color of the diseased tissues. The losses due to this disease will run from three to ten per cent of the navel crop and as the cultivation of the navel variety in the state is very extensive, the total losses are proportionately heavy.

---

[1] This original article was written by the author as a thesis for the degree of Bachelor of Science in the University of California. This presentation contains those portions of the thesis which we believe will be of most interest to the citrus growers of the State. Practically all the work was done under the direction of Prof. W. T. Horne, in the pathological laboratory at Berkeley, California. A little observation in the field was carried on in connection, but no experiments in infection work to date. It is proposed to carry on artificial inoculation experiments during the season of 1913, beginning with the blossoms and continuing until the fruit is full grown. Thus it is hoped the time and manner of natural infection will be ascertained and the study completed.

"Oranges are attacked through the navel, the fungous hyphæ entering through cracks or imperfections of the peel of those parts. The cells of the pulp sacks are destroyed, and soon become black in color and bitter to the taste. The peel is left uninjured until the disease has made considerable progress within, but finally becomes thin and darkened in color over the affected parts. The fungus vegetates freely among the pulp sacks, which are wholly destroyed as far as the mycelium extends but destruction of tissues rarely involves more than one fourth of the fruit, and is commonly confined to the tissues lying near to and at one side of the navel. Infected fruit ripens prematurely, showing an exceptionally high color, and soon falls from the tree.

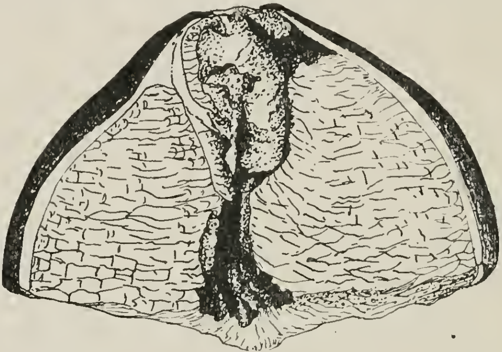

FIG. 324.—Drawing showing the course of the black rot from the navel to the heart of the orange. (Original.)

"The fungus inducing the disease is a new species of *Alternaria*, and its conidia are produced upon the surface of the affected tissues. The life-cycle has been studied by means of single spore cultures, and detailed descriptions and illustrations are reserved for publication, together with facts relative to infection and preventive treatment.

"From its habitat (inside the orange) and the character of the conidia this seems to be distinct from *Alternaria tenuis* Nees, on orange leaves." (As far as known, the reserved descriptions have not been published.)

In an appendix to Bulletin 107, University of Florida Agricultural Experiment Station, entitled "Catalogue of Rots, Spots and Blemishes on Citrus Fruits in Florida," appears the following account of this disease by Prof. H. S. Fawcett:

"Black Rot (*Alternaria citri*)—Rot beginning at the blossom (stylar) end, especially in navel oranges, sometimes in other varieties if there be a defect at the blossom end. Fruit ripening prematurely with a deep color. Decay causing a blackening along the central core of the fruit where the segments meet, not softening the fruit so rapidly as the previous rots. Decay more confined to the interior of the fruit and darker in color."

Description of Affected Oranges.

Oranges, in which the fungus has developed considerably, become exceptionally highly colored while other fruit on the same tree may still be green. Directly over the affected parts there is often found a light colored spot, though all do not show this. Affected oranges from the various districts show the same general characteristics. When an infected orange is cut in half longitudinally (through the navel to the stem end), the rot is revealed as a black area in the cells of the pulp sack, almost invariably near the navel and extending more or less deeply towards the heart of the fruit. (Figs. 324 and 325.) The affected area is usually comparatively small, generally one quarter to one half inch deep, but occasionally extending through the bulk of the pulp. The pulp and juice in close proximity to the affected area has a bitter taste, while the balance is more or less sweet and pleasant.

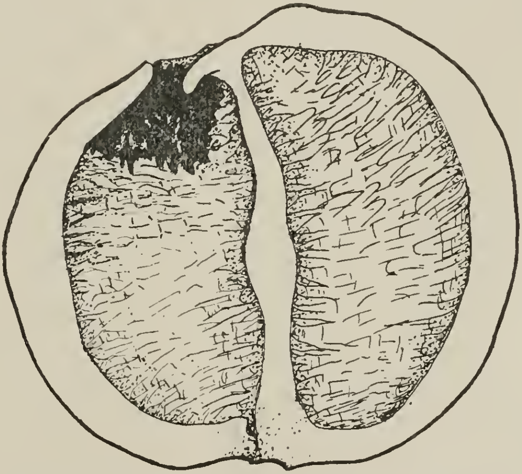

Fig. 325.—Opening in the navel tissue of this orange made infection an easy matter. (Original.)

Effect of the Fungus on the Fruit.

The fungus evidently exerts a stimulating influence upon the physiological processes of the fruit and even though the area affected is small, the whole orange is influenced and a high color produced. The black color of the affected tissues may be due to the action of a secretion by the fungus upon the cell tissue, or to the oxidation of a product of the fungus. The fungus seems to be able to make but a very weak attack upon the tissues and has very limited power of penetration. Unless the cell walls are very thin or there is an opening, the spread of the infection from cell to cell is very slow. After an orange is cut through the affected area the mycelium rapidly extends over the surface, finally covering the peel and causing the half orange to appear as a black, smutty mass. (Fig. 328.)

Distribution of the Disease and Its Relation to Climatic and Other Influences.

There is probably more or less infection of fruit by this fungus in every navel orange district in California. While it is primarily a navel orange disease it is occasionally found in other varieties. In the latter, however, it is found only when there is a crack or opening in the peel.

That this disease is found in Florida oranges also is recorded by H. S. Fawcett, in the appendix to Bulletin 107 of the Florida Experiment Station, as noted in the introduction.

There seems to be a direct relation between this disease and moisture. While the fungus is present in the interior, Fairoaks and Oroville, orange districts, so few oranges are affected that the loss is insignificant and no attention is given to it. The districts are typical of the hot, dry interior, and have practically no fogs or moisture-laden atmosphere in the spring and early summer, as the case in the southern orange districts. Coast conditions favor the development of the fungus, the fogs and late showers furnishing the necessary moisture for the germination of the spores which find lodgment in or near the navel. If, however, a spore finds lodgment well into the navel so that it is protected from the warm, dry air of the interior regions, the moisture of the fruit may be sufficient for germination.

The spring of 1908 in the southern sections was replete with fogs and late rains, and the market for navel oranges from some sections received a severe set-back, due to the high percentage of infection by this disease.

General Descriptions and Characters of Alternaria citri.

Mycelium.—Slender, hyaline or yellowish-hyaline threads, septate, often constricted at the septa, branched and rebranched, and bearing terminal conidia, singly or in series.

Walls of the mycelium are rather heavy, cells are generally 3.6 inches in diameter and 9.13 inches long, filled with a granular protoplasm and often contains vacuoles.

Spores.—Conidia are the only spores produced by this fungus. The young conidia are variously shaped; obovate, oblong-elliptical, or subglobose. 8.13 inches in diameter by 10.18 inches long, 2-3 celled, very little, if any, constriction at septa, surface smooth, color slightly yellowish hyaline to light olivaceous hyaline, occurring singly or two to three catenulate in series.

Older conidia are short-clavate-oblong, 15.25 inches in diameter by 24.40 inches long, 4-12 celled by transverse and longitudinal septa, more or less constricted at septa according to age, each cell when mature being almost spherical, filled with granular protoplasm and generally containing vacuoles. The surface is set with irregularly scattered tubercles (Figs. 326 and 327). Conidia often 3-6 catenulate in series arising from a simple or branched pedicel. Occasionally secondary conidia arise directly from the primary, which process has been found to continue until a chain of four conidia, with a short pedicel at the base of each, has been formed. This characteristic distinguishes this fungus from the *Macrosporium* and places it in the genus *Alternaria*.

Under favorable conditions conidia may be produced in forty-eight hours after transfer of a portion of mycelium from a pure culture to a plate or tube of sterile nutrient agar. Each cell of the conidia is capable of giving rise to a hypha.

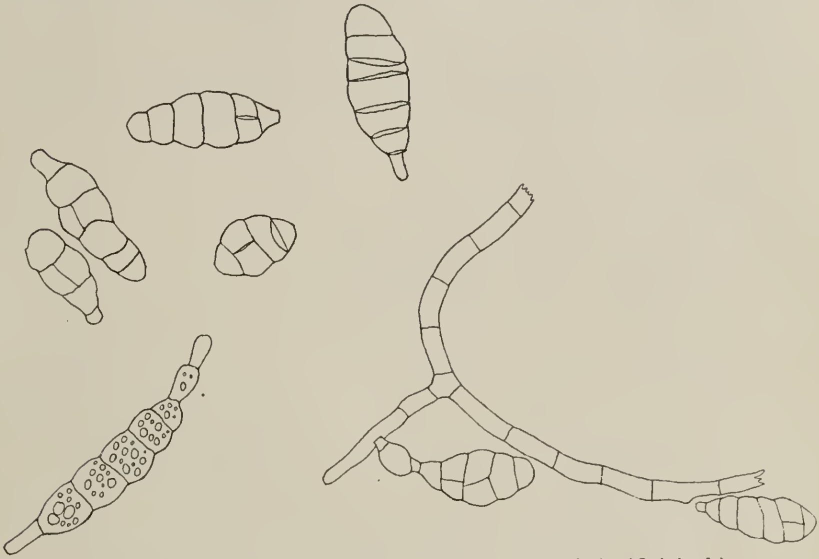

FIG. 326.—Conidia and mycelium of *Alternaria citri*. (Original.)

Inoculations of Oranges From Pure Cultures of Alternaria citri.

A large number of sound oranges were inoculated with spores or mycelium taken from either pure cultures made from affected oranges or directly from such oranges. Oranges from Fairoaks, Oroville, Whittier, Covina and Ensenada, Mexico, were used in the work.

Oranges were prepared for inoculation by being washed in 40 per cent formalin and, if cut, a sterile knife was used for that purpose. All moist chambers used were first washed with hot water and soap, and then rinsed out with 40 per cent formalin.

Spores were placed well into the navel in one series of experiments. No wounds were made in the tissues and no moisture was added. The purpose of this experiment was to ascertain if infection would take place simply through the lodgment of spores in the navel end. The structure and condition of the tissues of the navels were not known until after the oranges were cut open, which was about three weeks later. Green and mature oranges were used. When cut open, as stated, it was found that infection had not taken place in any case. No openings or imperfections of the navel tissues were found in these oranges.

In another series of experiments inoculations were made in the navels of ten oranges after making stabs into the navel tissue with a sterile knife. Upon examination, three weeks later, the fungus was found to have developed in five oranges out of the ten, producing the typical black rot with the characteristic spores and mycelium of *Alternaria citri,* while in the other five oranges the fungus failed to develop. It is possible that in the latter the spores were not lodged in the wounds and failed to germinate on account of lack of moisture.

In a series of experiments, extending over a period of about one year, twenty-two oranges were cut in half and each half inoculated with spores or mycelium from pure cultures made from affected oranges. In all cases the oranges were first washed with formalin and placed in sterile moist chambers. But two cases out of the forty-four inoculated, failed to develop the characteristic black rot of *Alternaria citri.* All cultures, (half oranges) which did not become contaminated with Pencillium species or *Mucor mucedo,* finally became black over the entire surface, including the peel. (Fig. 328.)

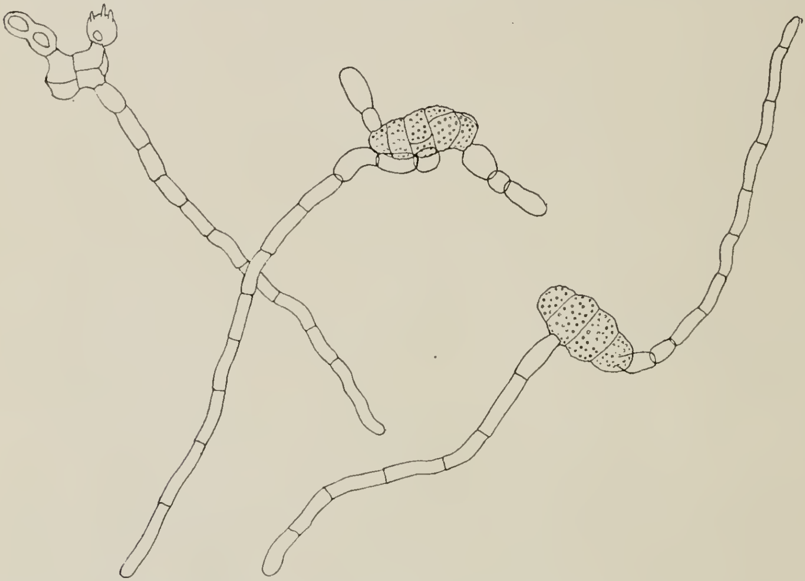

FIG. 327.—Germinating conidia showing the tubercles on the surface. Also showing character of mycelium. Magnified 1,000 times. (Original.)

Cultures were made from these artificially inoculated oranges and produced the characteristic spores and mycelium of *Alternaria citri.* A large number of sound half oranges were prepared as in the previous experiment, and inoculated with spores of mycelium from these cultures. All these inoculations were successful in producing the characteristic black rot of *Alternaria citri* and the typical spores and mycelium of the same.

Final Identification of Organism Causing Black Rot.

Judging by the preceding work, the fulfillment of the rules of proof in the preparation of cultures from affected oranges, inoculations, isolations of the fungus and its constant association of it with the disease, it can be stated with certainty *Alternaria citri* causes the disease known as "Black Rot of the Navel Orange."

Discussion of Probable Time and Manner of Natural Infection of Oranges.

Judging by the results of this work with the fungus and also by the examination of a large number of affected oranges from the various districts, the following conclusions have been tentatively arrived at, pending further investigations:

Alternaria citri is primarily a saprophyte and will propagate upon many kinds of vegetable matters, but it is a faculative parasite when entrance to the pulp cells of the orange is comparatively easy. The fungus may propagate in the orange groves upon fallen fruit or fruit left on the tree. Thus the spores may be quite prevalent in the spring when the fruit is young and tender. They may be carried by the wind and by insects to the navel or possibly to the blossoms, and, if there is sufficient moisture, develop germ tubes which enter the inner tissues, if there is an opening or imperfection.

It is not probable that infection takes place in the blossoms but rather after the oranges have grown enough to distend the navel opening. In every case of infection, except when the peel was split on the outside of the orange, there was found an opening between the convolutions of the tissue of the navel. One orange had two infections and was found to have an opening on each side of the center of the navel. The course of the fungus could be plainly traced from these openings. The fact that seedling varieties are seldom, if ever, affected also indicates that the extending navel is the place of infestation.

Discussion of Methods for Preventing Infection of Oranges.

As stated above, infection without doubt takes place through the navel. If, therefore, it were possible to eliminate the navel from the orange, infection would be impossible, except in case of a split in the outer peel. But as this would be a slow process, which would require many years, we must look for some other means to prevent infection.

In some sections spraying with lime and sulphur or Bordeaux Mixture for the withertip disease is practiced in the early spring. If applied at the proper time this may serve to prevent a large percentage of infection by spores of *Alternaria citri.*

It is very probable that if a fungicide, such as lime and sulphur or Bordeaux Mixture, was applied well into the navel, just after the latter was distended, infection would be prevented by the destruction of the germ tube of any spore present. Until the time of infection and the manner in which it takes place is exactly determined, remedial measures are mere conjectures, based upon observation and theory. Opportunities for the propagation of the fungus should, if possible, be eliminated. In this connection it might be suggested that no fruit be allowed to remain on the trees or ground from one season to another to furnish spores for the infection of the new crop. One infected orange may furnish a million or more spores to be disseminated to the young fruit in the spring. Other vegetable matter should not be allowed to rot in or near the orange groves, as the fungus will propagate upon almost any kind.

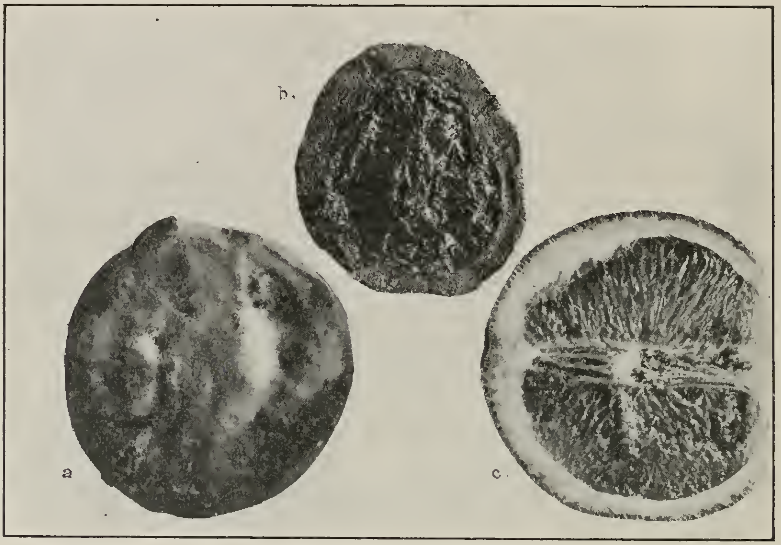

FIG. 328.—(*a*) Half orange two months after inoculation with mycelium from a pure culture of *Alternaria citri.* The cut surface and the peel is completely covered with a fungous growth and appears as a black smutty mass with some whitish colored secondary mycelium over parts. (*b*) Half orange inoculated as the above (*a*) and covered in the same manner, but cut in two, showing that it is blackened throughout the interior as well as the exterior. (*c*) Unaffected half orange shown as comparison with the above. (Original.)

Summary.

1. *Alternaria citri* Pierce and Ellis, a fungus, is the cause of the Black Rot of the Navel Orange.

2. This fungus will propagate upon many kinds of vegetable matter and the conidia are disseminated to the blossoms or fruit (most probably the latter) in the spring or early summer.

3. This fungus is primarily a saprophyte but becomes a parasite if introduced into the fruit.

4. As it is very difficult to apply a fungicide in the navel of the orange the advisable method of preventing infection seems to be the elimination of wintering over and breeding places of the fungus. This means the destruction or removal of all decaying vegetable matters in or near the orange groves.

SWEET POTATO WEEVIL.

Cylas formicarius Tryon.

By Frederick Maskew.

It is a common saying that every one in the world passes through the Ferry Building once in his lifetime. Such statements, of course, are not susceptible of proof. However, we are almost ready to believe that specimens of every insect pest so far recorded eventually find their way into the quarantine station located in the Ferry Building at San Francisco. It would be a coincidence for a vessel arriving from any Oceanic or Oriental port to remain at the dock in San Francisco for a week without some one of the quarantine force finding either in the ship, the freight or in the belongings of the passengers specimens of some insect pest not yet known to exist in the State. Horticultural freight from the Orient makes ideal hunting ground for bug catchers, and the quarantine service has always been fortunate in that its bug hunters, without exception, have all been enamoured of their occupation. The particular pest we are dealing with in this article was found at work by inspectors B. B. Whitney and Lee A. Strong in a shipment of sweet potatoes brought by the S. S. ''Nile'' from China, and again by inspector Lee A. Strong in a similar lot of sweet potatoes brought by the S. S. ''Mongolia'' from China on September 6, 1912. This pest has unquestionably been taken and destroyed by quarantine officers many times in the past, but I find no record of the same in the quarantine annals.

The illustration of the insect in its several stages (Fig. 329) which was reproduced from the original of T. Shiraki's ''Injurious Insects of Formosa,'' volume 1, also shows clearly the destructive work of the larvæ in the interior of the potato. A superficial view of an infested specimen reveals no evidence of this attack upon the tissues other than the minute hole through which the larva has entered, and the full extent of the ravages is not apparent until the potato is cut open.

Figure 330 represents an actual specimen of an injured tuber taken at quarantine with four of the weevils *in situ*. From our hurried observations we are of the opinion that the extensive cavities shown herewith are the work of the adult weevil, and demonstrate clearly its ability to reduce market values, even of stored potatoes.

Cylas formicarius is a very widely distributed species, and a native probably of Cochin China. Compere has a record of finding it at Bombay and also at Calcutta in sweet potatoes offered for sale in the public markets at both of those places. It has also been reported from Madagascar, Southern United States, West Indies and Northern Australia; but not yet so far from the sweet potato fields or markets of California.

It also occurs in the Hawaiian Territory, and was recorded as a pest by Van Dine in 1907, whose excellent description of its appearance and history we herewith reprint[1]:

"The beetle is somewhat ant-like in form. The color of the elytra (wing covers) and of the head and beak is bluish black; that of the prothorax is reddish brown. The yellowish white oval eggs are laid in small cavities eaten by the parent beetles near the stem end of the tuberous roots. The milk-white larvæ bore little tunnels through the root in all directions, so that the vine dies; and frequently the entire potato is

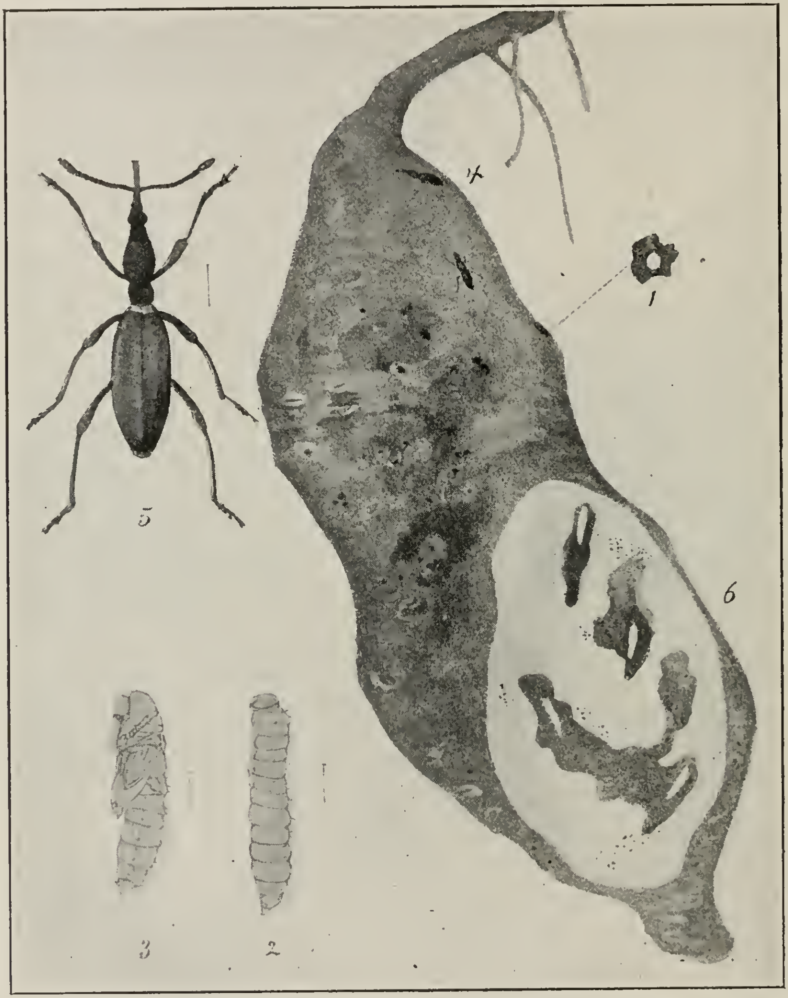

FIG. 329.—The sweet potato weevil, *Cyclas formicarius* Tryon. 1, egg; 2, larva; 3, pupa; 4, adults—all natural size; 5, adult greatly enlarged; 6, showing work of larva on interior of tuber. (After Shiraki. Photo by Archie Chatterley.)

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[1] Hawaii Station Report, 1907.

tunneled; these burrows become filled behind the larvæ with excrement. When about to assume the pupa state, the insect forms an oval cavity at the end of its burrow, where it undergoes its transformation.''

We have no suggestions to offer as to any methods of controlling its ravages in the fields or store room, in fact, we are not concerned with remedies; our special function in the general scheme of horticultural economics, is to prevent the necessity of having to offer remedies. The methods we employ at quarantine for such purposes can not be considered as embodying any desirable economic features, consisting as they do of the complete destruction of both the contents and container of material found infested. However, this shortcoming on our part in the matter of remedial measures for this particular pest (and for other imported pests in general), need not cause any uneasiness among sweet potato growers in California. This insect is not recorded as being in the State at the present time, and if there is any virtue in diligent, vigorous concerted effort in the inspection of horticultural imports, it is not going to get there for some time to come.

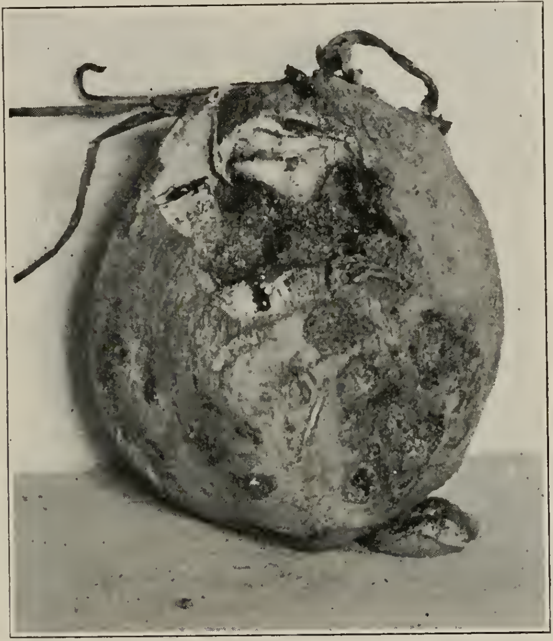

FIG. 330.—Sweet potato taken at quarantine, showing destructive work of adult sweet potato weevils on stored potatoes. (Original. Photo by Archie Chatterley.)

THE DATE PALM SCALES AND THEIR CONTROL.

By W. E. Wilsie, County Horticultural Commissioner, El Centro, Cal.

It is not generally known, but with the introduction of the edible date into this state, there were also introduced two of their enemies, date scales, *Parlatoria blanchardii* (Targ.) and *Phœnicococcus marlatti* (Ckll.).

Little could be learned about these scales in their native home, only that they were present. What amount of damage was really done by them was for some time, and in a degree still is, a matter of conjecture. but the longer it is studied the more serious it seems to be. No natural enemies have ever been found and it was necessary to resort to artificial means to keep them in control.

In the case of the *Parlatoria blanchardii* no remedy was entirely successful for more than temporary control until after the San Francisco fire, when it was found that ornamental palms withstood the tremendous heat and put out new leaves at once after the fire.

The burning remedy was then tried on the Tempe date garden in Arizona with success and later many trees were entirely cleaned by this treatment. The method being to defoliate the tree completely to the stump, which is burned over with a gasoline torch.

The *Phœnicococcus marlatti* has been even more persistent than Blanchard's scale, for the reason that it works behind and at the base of the leaves, out of sight and out of the light. Little is known of the life history of this scale but it is certain that its work is done upon the vital parts of the plant. Palms, different from ordinary trees and shrubs, grow from the base of the leaf—the whole leaf being pushed out. It is on the tender new growth at the base that this scale, a sucking insect that covers the entire tender surface near the heart of the plant, feeds. The fruit stalks, through which all the nourishment for from a few pounds to as much as seventy-five pounds of fruit must pass, are, when young, exceedingly tender and brittle. Upon these the scale becomes so thick as to cover the entire surface.

Many remedies have been tried to eradicate this pest without success, for any treatment that was effective on the scale injured or killed the plant. Many plants were killed by the experiments. The first remedy that has given even a ray of hope was a preparation or solution compounded by W. T. Taylor, now of the Sun Drug Company of Los Angeles, for mealy bug. This solution was tried early last spring and different series of experiments were carried on during the summer on both Blanchard's and Marlatt's scales with a degree of success that is almost unbelievable after the experience with other treatments.

We are now able to kill both scales without injury even to the fruit on the tree. Trees have been treated during the pollinating season and the solution sprayed in large quantities on the fruit just forming with no bad results.

Having proven that a remedy had been found that was effective without injury to the plant, it was a matter of detail to work out a plan whereby all the scales could be reached by the solution. At the present time, for offshoots a vat is used that will hold a number which are immersed for a short time. This treatment is repeated a few hours later. Nearly all the scale are killed by these two treatments, but not all. In some cases air bubbles form so that the saturation is not complete. In other cases the fiber is drawn so tightly that small spots will occasionally escape treatment and on these dry spots enough live Marlatt's scale will be found to give a good start again. In the case of Blanchard's scale on the offshoots some of the leaves will be folded so closely that all parts are not wet and so occasionally one of these is left unharmed.

At present, offshoots, treated in this way, are placed in nursery rows under quarantine for twelve months. This is done to watch developments. What the future regulations will be can only be determined by the results of our experiments. The future plans are not definitely worked out, but from experiments thus far carried on it seems reasonably certain that these pests need never give any serious trouble.

FUNGUS GARDENS CULTIVATED BY ANTS.

By H. S. Fawcett.

One of the most interesting relations that exists between plants and insects is that in which a definite species of fungus is cultivated and tended with the greatest of care for food by the parasol ant of Brazil. Citrus trees, among others, in that region are stripped of their leaves to supply suitable culture media for the chosen fungus. Shimper[1] gives a very interesting account of this relation in "Geography of Plants" from which the information in this article is obtained.

Streams consisting of pieces of foliage of considerable size will be seen traveling in a definite direction. On close inspection these will be seen to be borne on the heads of ants. The pieces are cut from the margins of the leaf by shear-like mandibles, and placed on the head of the ant by a jerking motion and off the ant goes toward the nest. Sometimes the ants are so active as to strip the chosen plant of all foliage except ribs and petiole. They have been known to travel a half mile from their nests to obtain the right species of plant. They select and reject certain plants in turn probably for the purpose of getting just the right mixture.

A small part of the pieces of foliage is used to line the underground nests, but most of it is cut up again by the ants and kneaded soft by their feet and mandibles, until few cells remain unbruised. This is worked up into a porous spongy mass. This constitutes the fungus garden. Throughout the mass there grows the mycelium of a certain definite species of fungus which the ants always keep alive in their nests. This fungus at first sends out small projecting stalks on the top of which are swollen bodies full of protoplasm, known as kohl-rabi clump, which are used as the sole food of the ants. These are specialized bodies that tend to form and then disappear unless the vegetative filaments are kept down. The ants, even the youngest females, carefully keep the filaments nipped off as they begin to grow so that the fungus will continue to form the kohl-rabi clumps. Contaminating or undesirable mold fungi of many kinds always tend to spring up like weeds and crowd out the desirable fungus. The ants also guard against this and carefully nip off any foreign organisms that show themselves, as a gardener would keep down the weeds in his tomato patch. In this way the ants keep a pure culture of their favorite mushroom.

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[1] Shimper, Geography of Plants, p. 134.

Alf. Moller[1] was the first to investigate and prove the truth of this interesting relation between the ants and the fungus. By finding that the fungus at times produced a large mushroom growth above the nests, he was able to identify it as a new species of *Rozites* (*Rozites gongylophora*) a form that has never been found except in connection with nests of the parasol ants.

The damage done by these parasol ants to citrus trees in some tropical countries is very great, because of the almost complete stripping off of the leaves in which to grow the spawn for the ants' mushroom cellar.

It is fortunate that the California fruit grower does not have to supply food for an ant of this nature.

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[1] Alf. Moller, Botan. Mitthiel. aus den Tropen Heft. VI. Jena, 1893.

GENERAL NOTES.

QUARANTINE WORK IN SOUTHERN CALIFORNIA.

The itemized report for the month of February, 1913, from the Los Angeles Station of the State Quarantine Division shows sufficient importations of horticultural products into Southern California to indicate a busy month for those having in charge the inspection of these shipments. During the month 6,883 packages have arrived, been intercepted and inspected. Some idea of the magnitude of this total may be obtained when it is stated that 138 carloads of horticultural materials were rated in it as parcels.

Undeterred by the severe weather of the winter, the nurseries and seed men give daily evidence of their confidence in the continued prosperity of the State. This fact is well illustrated by the statement that 200 bushels of orange seed were imported from Florida in February.

To Mr. C. H. Vary belongs the credit for the most important capture of the month. This consisted of a bale containing ten gardenias from Georgia. This shipment was consigned to a resident of Los Angeles and contained a bad infestation of citrus white fly (*Aleyrodes citri.*) This package was accompanied by the customary certificate of inspection carrying the assurance that the contents were clean and free from any insect pests.

During the month, five cars of deciduous nursery stock from Oregon entered Los Angeles. Arrived at this point, they were broken up into individual shipments and sent out from this center throughout Southern California. Preceding each consignment thus forwarded, notice was sent from this office to each Quarantine Guardian notifying him of material in transit to points within his jurisdiction. By this means a careful and prompt inspection was secured for each shipment.

To the Los Angeles County Horticultural Commissioner, our heartiest thanks are due for the use of telephonic and office facilities. Owing to the thorough co-operation accorded this branch of the State Quarantine Division by Mr. Wood and his entire force it has been possible for the quarantine work in Los Angeles and vicinity to go forward with the required dispatch.—A. S. Hoyt.

LADYBIRD BEETLES.

We have collected this year many more of *Hippodamia convergens*, or our most common ladybird beetle, than ever before. Last year we collected the most up to that time—forty-four million, or twelve hundred boxes. This year we have collected fifty-three million, or sixteen hundred boxes.

There is a very general belief among the fruit and melon growers that these ladybirds are a great help. We have reason to believe they are right. We are sending them out much earlier this year than ever before. Next year we shall probably send them even earlier, shipping direct from the mountains to Imperial Valley and other places, where they are needed. This will save largely of expense and from our observation this year in the field we believe they will breed up rapidly and therefore the numbers will be greater as the cantaloupes become infected with the aphids.

We sent some of the ladybirds to the barley field early in the season this year, and Mr. Harry S. Smith, superintendent of the State Insectary, found them breeding very rapidly. The people of Imperial Valley are very confident they are receiving great help from these little predators.—A. J. Cook.

FROSTS.

The great freeze of the winter, which did such harm in the south, has been followed by numerous frosts reaching far into the north. While considerable harm has been done, it is hoped that it is not as serious as was at first feared.—A. J. Cook.

HORTICULTURAL LEGISLATION.

A word regarding the bills relating to horticulture will be of special interest to our readers. The act concerning the office of the State Commissioner of Horticulture does not materially change the administration. Instead of one deputy quarantine officer we will have two—one at San Francisco and the other at Los Angeles. The salary will be the same as heretofore. The plant pathologist with the two just mentioned will be in the statutory list.

In the budget we are especially interested in The Monthly Bulletin. For the last two fiscal years we have only issued nineteen instead of twenty-four numbers, as I did not take office until October, 1911. The circulation is increasing so rapidly that we feel we must have five thousand dollars more for the next two fiscal years.

We are now also fully equipped to win success in securing parasitic and predaceous insects from the Orient. As is well known, almost all of our fruits have been grown in the Orient for many years. Our worst pests are nearly all there, and yet do little harm. Does this not suggest that we should at once be engaged in this direction? We ask for twelve thousand dollars for this work. I believe we shall gain in both these matters as it would be almost criminal neglect in not grasping so promising an opportunity.

A second bill provides for inspection of seeds. This has only to be mentioned to win support. I believe it will meet with little opposition.

The Slater bill has caused very much discussion and has met with some opposition. The bill calls for the same painstaking in giving information as to intercounty shipments, especially of nursery stock, that we now have in interstate. It also provides that county horticultural commissioners shall have power to enforce county ordinances. The nurserymen and many others greatly desire that county ordinances shall not be operative until approved by the State Commissioner of Horticulture. This last clause is favored by many of the county horticultural commissioners, though some are very strongly opposed to this action.

The fourth bill has to do with bee inspection, providing for a civil service examination for inspectors and also for a state apiarian. It is thought by those best qualified to judge that this will be one of the best foul brood laws ever passed by any state.

A few other bills, should they pass, would certainly work harm. They would remove the civil service examination for county horticultural commissioners and leave their appointment and removal solely in the hands of the supervisors.—A. J. Cook.

MONTHLY CROP REPORT—APRIL.

These data are compiled by the secretary from monthly crop reports made by the county horticultural commissioners. Counties not included have not reported or the reports have come too late for press.

Alfalfa.

Glenn.—Good crop. *Los Angeles.*—Estimate of crop amounts to 14,271 tons. *Sacramento.*—Full crop. *Solano.*—60 per cent of normal crop. *Tulare*—75 per cent of normal crop.

Almonds.

Colusa.—One-quarter of crop which amounted to 600,000 pounds last year. *Glenn.*—60 per cent of normal crop. *Lake.*—Only one-tenth of a full crop, due to frost. *Madera.*—Half a crop. *Mendocino.*—No crop at all. *Monterey*—20 per cent of last year's crop. *Napa.*—Nearly all killed by frost. *Placer.*—One-quarter of a crop, or about 15,000 pounds. *Riverside.*—Full crop. *Sacramento.*—25 per cent of last year's crop. Early varieties killed by frost. *San Joaquin.*—Almost a complete failure, due to frost. *Shasta.*—No crop. *Stanislaus.*—Only 3 per cent of normal crop, due to frost. *Sutter.*—Half a crop. *Tehama.*—Last year's crop, 200,000 pounds; only one-quarter of a crop this year. *Yuba.*—Last year's crop amounted to 9 tons; only 60 per cent of this will be produced this year.

Apples.

Inyo.—50 per cent more than last year's crop, which amounted to 1,250,000 pounds. *Lake.*—Half the crop of last year. *Lassen.*—Full crop. *Mendocino.*—Full crop. *Monterey.*—Too early for estimate. *Nevada.*—Short crop. *Placer.*—Too early for estimate. *Riverside.*—Prospects for full crop. *Sacramento.*—Full crop. *San Bernardino.*—Look well, but too early for estimates. *San Diego.*—Full crop. *Santa Barbara.*—Full crop, of about 7,521,325 pounds. *Santa Cruz.*—Newton Pippins, average 75 per cent; Bellflowers blooming well; other varieties from 80 per cent to full crop. *Siskiyou.*—Too early for report. *Stanislaus.*—Full crop. *Sutter.*—Three-quarters of a crop. *Yuba.*—Full crop of 100 tons.

Apricots.

Alameda.—From 45 per cent to 50 per cent of full crop. *Colusa.*—One-quarter of a crop. *Glenn.*—40 per cent of crop. *Inyo.*—Half of last year's crop; practically a failure. *Kings.*—Half a crop, because of frost. *Lake.*—Less than one-quarter of crop; buds frozen. *Madera.*—One-quarter of crop. *Monterey.*—Twice the crop of last year; heavy. *Napa.*—Nearly all killed by frost. *Nevada.*—Light. *Orange.*—25 per cent of crop, due to March frost. *Placer.*—60 per cent of crop. *Riverside.*—Big crop. *Sacramento.*—80 per cent of last year's crop, due to frost. *San Bernardino.*—Good crop on trees. *San Joaquin.*—Failure with but few exceptions; due to frost. *Santa Barbara.*—

1,495,921 pounds or normal crop. *Santa Clara.*—Other reports show estimated crop of about 50 per cent. *Santa Cruz.*—Full crop. *Shasta.*—No crop. *Solano.*—10 per cent of last year's crop. *Stanislaus.*—10 per cent of crop, due to frost. *Sutter.*—Three-quarters of crop. *Tehama.*—1,000,000 pounds or half of crop. *Tulare.*—40 per cent of crop. *Ventura.*—Half a crop, due to March frost.

Beans.

Glenn.—40 per cent of normal crop. *Orange.*—Short, unless more rain. *Sacramento.*—48,000,000 pounds, or full crop. *Ventura.*—Prospects for normal crop of limas.

Berries.

Los Angeles.—Prospects for 456 tons of strawberries. *Sacramento.*—8,000,000 pounds, or full crop. *Shasta.*—Fair crop. *Stanislaus.*—Full crop.

Cherries.

Alameda.—Promise fine crops where irrigated. *Lassen.*—Full crop. *Mendocino.*—One-half crop. *Napa.*—Light crop. *Nevada.*—Prospects for full crop. *Placer.*—70 per cent of full crop. *Riverside.*—Full crop. *Sacramento.*—3,600,000 pounds, or 90 per cent of normal crop. *San Bernardino.*—Promise bumper crop. *San Joaquin.*—One-quarter crop, due to frost. *Santa Barbara.*—More than normal crop, about 79,212 pounds. *Santa Cruz.*—Full crop. *Shasta.*—Good crop. *Solano.* Same as for last year. *Stanislaus.*—Full crop.

Figs.

Colusa.—Full crop estimated, though a little early. *Sacramento.*—Full crop of 300,000 pounds. *Solano.*—Normal crop. *Stanislaus.*—Full crop.

Grain Hay.

Lassen. — Good crop. *Orange.* — Short. *Tulare.* — One-half crop. *Ventura.*—Short crop.

Grapes (Wine).

Placer.—Light crop. *Sacramento.*—Full crop. *San Bernardino.*—Look good. *Stanislaus.*—Full crop. Other counties too early for estimate.

Grapes (Table).

Placer.—Light crop. *Sacramento.*—Full crop. *Stanislaus.*—Full crop. Too early for estimate in other counties.

Hops.

Lake.—Too early for estimate. *Sacramento.*—8,000,000 pounds, normal crop.

Lemons.

Glenn.—No frost injury; few bearing trees, many just planted. *Los Angeles.*—Included with oranges. *Orange.*—Look good where not frost injured. *Riverside.*—About 60 per cent of normal crop. *Sacramento.*—Normal crop of 720,000 pounds. *San Bernardino.*—Scarce, except in frostless areas. *San Diego.*—15 per cent of crop. *Santa Barbara.*—98 per cent of normal crop. *Ventura.*—Normal, about 565 cars.

Olives.

Placer.—60 per cent of crop. *Sacramento.*—Full crop of 1,500,000. No other reports.

Oranges.

Colusa.—Good bloom. *Los Angeles.*—Total citrus crop estimated at 7,440 tons. *Orange.*—Good bloom. *Placer.*—70 per cent of crop. *Riverside.*—60 per cent of normal crop. *Sacramento.*—Full crop of 6,000,000 pounds. *San Bernardino.*—Fair bloom. *San Diego.*—40 per cent of normal crop. *Santa Barbara.*—Full crop of 135,805 pounds. *Tulare.*—Prospects for good crop. *Ventura.*—Normal crop of about 430 cars.

Peaches.

Alameda.—Full crop if not a dry year. *Colusa.*—One-quarter crop, due to frost. *Glenn.*—80 per cent of crop. *Inyo.*—Good crop. *Kings.*—Normal, but slightly frosted. *Lake.*—One-quarter normal crop, due to frost. *Madera.*—60 per cent of normal crop. *Mendocino.*—One-quarter normal crop. *Napa.*—No crop at all. *Nevada.*—One-half crop, due to frost. *Orange.*—Prospects for good crop. *Placer.*—70 per cent of crop. *Riverside.*—Heavy crop. *Sacramento.*—80 per cent of last year's crop; Salways and Tuskena injured by frosts. *San Bernardinio.*—Good crop. *San Diego.*—Prospects for full crop. *San Joaquin.*—Muirs good; Elbertas three-quarter crop; other varieties normal. *Santa Barbara.*—Good crop. *Shasta.*—Good crop in upland districts, but no crop in lowlands. *Solano.*—Same as last year. *Stanislaus.*—Thirty-five per cent of crop, due to frost. *Sutter.*—Muirs, three-quarters crop; other varities full crop. *Tehama.*—One-half crop. *Tulare.*—65 per cent of full crop. *Yuba.*—70 per cent of full crop.

Pears.

Alameda.—Good bloom and setting. *Inyo.*—50 per cent better than last year's crop of 600,000 pounds. *Lake.*—Larger than last year's crop of 3,000,000 pounds. *Mendocino.*—One-half crop. *Monterey.*—Full crop. *Napa.*—Good crop. *Nevada.*—Bartletts promise 85 per cent of crop; winter varities full crop. *Orange.*—Full crop. *Placer.*—95 per cent of full crop. *Riverside.*—Normal. *Sacramento.*—90 per cent of last year's crop of 30,000,000 pounds. *San Joaquin.*—Good crop. *Santa Barbara.*—Good crop. *Santa Cruz.*—Full crop. *Shasta.*—Good crop. *Solano.*—10 per cent better than that of last year. *Stanislaus.*—Full crop. *Sutter.*—Three-quarters of crop. *Yuba.*—One-half crop.

Plums (shipping).

Inyo.—Normal crop of 150,000 pounds. *Mendocino.*—No crop. *Nevada.*—Excellent crop promised. *Placer.*—70 per cent of last year's crop, which amounted to 26,600,000 pounds. *Sacramento.*—80 per cent of the 12,000,000 pounds produced last year. *San Joaquin.*—Full crop. *Solano.*—Equal to last year's crop. *Stanislaus.*—40 per cent of normal crop. *Sutter.*—Three-quarters crop. *Tehama.*—One-quarter crop of about 300,000 pounds. *Tulare.*—One-half crop. *Yuba.*—60 per cent of normal crop or about 18 tons.

Potatoes.

Los Angeles.—Estimated crop of 1623 tons. *Sacramento.*—Full crop of 60,000,000 pounds.

Prunes.

Colusa.—75 per cent of full crop. *Glenn.*—80 per cent of normal crop. *Lake.*—Larger than last year's crop of 1,800,000 pounds. *Mendocino.*—One-quarter crop. *Napa.*—Light crop. *Nevada.*—Good crop. *Riverside.*—Two-thirds normal crop. *Sacramento.*—Three-quarters of last year's crop of 9,000,000 pounds. *San Joaquin.*—Heavy bloom promises good crop. *Shasta.*—Fair crop promised. *Solano.*—Crop equal to last year's. *Stanislaus.*—40 per cent normal crop. *Sutter.*—Three-quarters crop. *Tehama.*—40 per cent of last year's crop, which amounted to 7,000,000 pounds. *Tulare.*—One-half crop. Without data from Santa Clara County definite reports cannot be made.

Walnuts.

Inyo.—Full crop of 120,000 pounds. *Lake.*—Full crop. *Orange.*—No frost injury and good prospects for big crop. *Riverside.*—Normal. *Sacramento.*—Normal crop of 300,000 pounds. *Santa Barbara.*—Heavy blooming indicates good crop.

NOTES FROM THE COUNTY COMMISSIONERS.

El Dorado County.

Mr. J. E. Hassler, county horticultural commissioner, has tendered his resignation to the board of supervisors. Many of the fruit growers, realizing the seriousness of losing his valuable services, are urging him to reconsider his action. It is sincerely hoped that he will see his way clear to do so.

Glenn County.

Mr. Carl J. Ley has been appointed county horticultural commissioner of this increasingly important horticultural county. He has already inspected and passed thousands of fruit trees.

Imperial County.

Commissioner Wilsie reports 30,000 acres of cotton in his county for this year. The Bureau of Entomology of the Department of Agriculture has placed H. Pinkus to study cotton insects and J. D. Neuls to study the date scales.

Lake County.

Excellent specimens of walnuts recently received from Commissioner Geo. A. Lyons prove his county to be adapted to the culture of this valuable crop.

Modoc County.

An examination for county horticultural commissioner was held at Alturas, May 1, 1913.

Nevada County.

Mr. D. F. Norton, a prominent fruit man of Grass Valley, qualified and was appointed successor to Mr. Bree, whose death occurred some months ago. Mr. Norton has always been very active in the interests of horticulture in Nevada County and his success is assured.

San Bernardino County.

Commissioner S. A. Pease reports the presence of the potato tuber moth (*Phthorimaea operculella*) in his county.

San Diego County.

On January 1st Mr. H. A. Weinland was appointed county horticultural commissioner to succeed Mr. C. H. Stuart. Since qualifying for this position in 1909 Mr. Weinland has been actively engaged in horticultural work as expert of the State Commission at Honolulu and as assistant superintendent of the State Insectary.

San Francisco County.

Several unsuccessful attempts have been made to secure the appointment of a county horticultural commissioner to look after the large export and nursery trade in that county, but the board of supervisors refuses to call for an examination. It is to be hoped that before long such an officer will be appointed there.

San Luis Obispo County.

A petition is being circulated among the fruit growers of this county, seeking to secure the qualifying and appointment of a county horticultural commissioner.

Santa Barbara County.

Deputy county horticultural commissioner R. C. Wiley has sent to the State Commission specimens of potatoes grown in the Lompoc Valley infested with the potato eelworm.

Siskiyou County.

Commissioner Joseph F. Wetzel has found that parsnips in his county become seriously affected with the potato eelworm. The increasing amount of data shows that this pest is widely distributed over the state, having been found in many counties.

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VOLUME II No. 6

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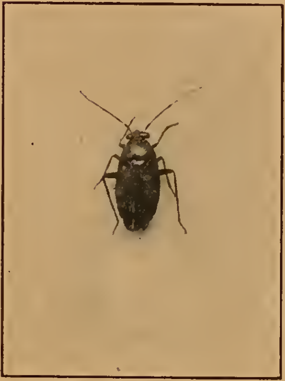
THE MONTHLY BULLETIN



Irbisia brachycerus Uhler, a new garden pest. Twice enlarged (Vosler).

OF

STATE COMMISSION OF HORTICULTURE

SACRAMENTO, CALIFORNIA JUNE, 1913

Printed at State Printing Office, Friend Wm. Richardson, Superintendent.

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STATE COMMISSION OF HORTICULTURE

June, 1913

THE MONTHLY BULLETIN

VOLUME II No. 6

DEVOTED TO THE DESCRIPTIONS, LIFE HABITS AND METHODS OF CONTROL OF INSECTS, FUNGOID DISEASES AND NOXIOUS WEEDS AND ANIMALS, ESPECIALLY IN THEIR RELATIONS TO AGRICULTURE AND HORTICULTURE.

EDITED BY THE ENTIRE FORCE OF THE COMMISSION UNDER THE FOLLOWING DIRECTORS:

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SACRAMENTO, CALIFORNIA
1913

A NEW FRUIT AND TRUCK CROP PEST.

(*Irbisia brachycerus* Uhler.)

Order—Hemiptera. **Family—Capsidæ.**

By E. J. Vosler, Assistant Superintendent State Insectary, Sacramento, Cal.

The attention of the Insectary has been called to the injury of garden crops and fruit by a small shiny black plant bug about two tenths of an inch in length, belonging to that type of insects which sucks the

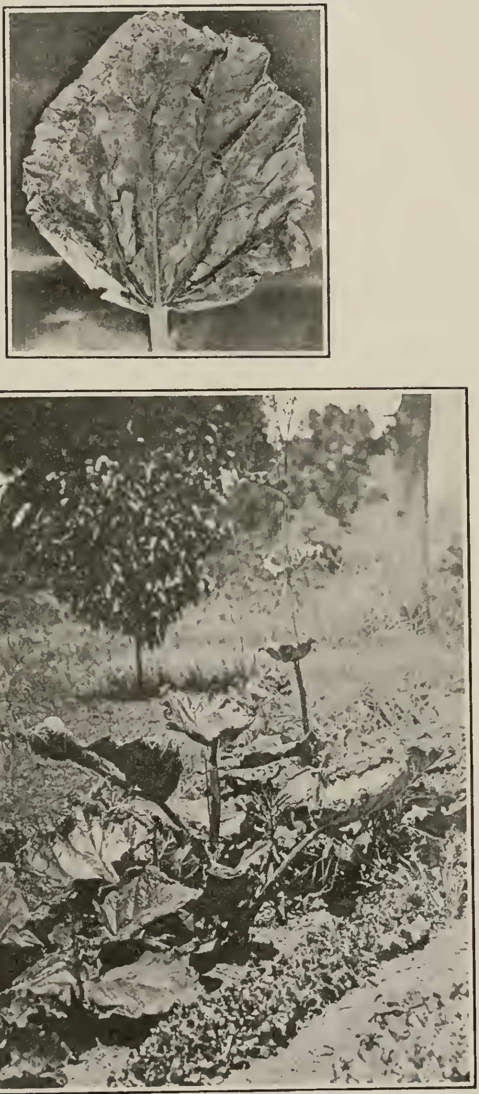

Fig. 331.—Work of *Irbisia brachycerus* Uhler. Top, rhubarb leaf damaged by the plant bug; bottom, rhubarb plants showing curled leaves due to the insect's attack. (Original.)

juices from the host plant with a sharp beak. Specimens were received from Mr. C. R. McBride, County Horticultural Commissioner of Solano County, with a report that they were doing serious damage to the fruit of peaches by puncturing the skin and causing the sap to ooze out. Complaint was also sent into the Insectary by Mr. Elmore Chase at Fairoaks that a small black plant bug was doing considerable injury to garden crops in his locality, and that the pest was spreading rapidly.

On visiting the infested territory I found that the insect was common on both the garden crops and on the weedy growth of the uncultivated areas several miles from the damaged garden. Even the wild cucumber vines on the bottom near the American River had their share of the pest.

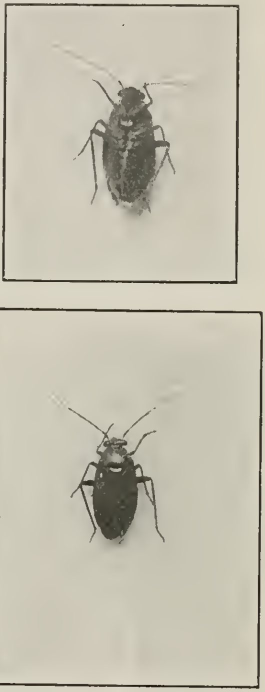

FIG. 332.—Ventral and dorsal views of *Irbisia brachycerus* Uhler. Enlarged twice. (Original.)

Of the vegetables in the infested garden, consisting of lettuce, radishes, onions and rhubarb, the radishes and rhubarb seemed to be the insect's particular favorites.

The rhubarb leaves were badly curled at the tips which were dead and the surfaces were streaked with dead discolored portions. Hundreds of the insects were found to be sucking out the juices of the host, for the most part, from the under side of the leaves. They were quite active and easily dislodged by shaking the plants but would soon crawl back up the stems and on to the leaves. The radishes were almost entirely killed out. Roses in the neighboring garden presented a sorry appearance, nearly every flower having the tips of the petals blackened and dried from the vicious attack.

It was noted in connection with the examination of the injury done by the plant bug that no eggs or other immature stages could be found. This led to the conclusion that the insects had either migrated from natural food plants which had dried up, thus forcing them to look elsewhere in search of food, or that it was too early in the season for egg production to take place. Two weeks later the infested gardens were revisited and to my surprise the garden crops were entirely free from the pests, although here and there among the weeds and grasses of the adjacent land a few specimens could be obtained, lending further proof to the statement that the infestation was due to a migration caused by the drying up of its natural host.

From the fact that the insect was distributed over such a large uncultivated area at Fairoaks contact poisons are out of the question unless used frequently, because reinfestation would soon be the result. A repellent which would drive them away seems to be the solution of the problem, but unfortunately time and opportunity did not permit of experiment with the various methods of control. Possibly an application of Bordeaux mixture, which is considered a good repellent as well as a fungicide, light enough to prevent burning of the foliage, or lime, in the proportions of 25 pounds stonelime to 100 gallons of water and sprayed on the leaves will drive them away. Experiments will be conducted to determine the value of these sprays against this insect if it makes its further appearance.

Mr. E. P. VanDuzee has found this species to be common on grasses and weeds at San Diego, California, and has recorded it as being distributed over California, Colorado, Washington, Idaho, New Mexico and in the Wasatch Mountains of Utah. Mr. Otto Heideman records it as common on lupine and injurious to potato plants in this State.

This capsid was kindly determined by Mr. Van Duzee as *Irbisia brachycerus* Uhler. It has been recently redescribed as *Capsus solani* by Mr. Heideman.[1]

If the grower, who has noticed damage to his crops of a nature similar to that described in the preceding paragraphs, will take the trouble to send in a few specimens in a small vial or box to the Insectary, we will be glad to identify them and to make suggestions regarding experiments for their control.

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[1] Proc. Ent. Soc. Washington. Vol. XII, No. 4, pages 200-201.

THE WALNUT MEALY BUG.

(*Pseudococcus bakeri* Essig.)

Order—Hemiptera. **Family—Coccidæ.**

By R. S. VAILE, County Horticultural Commissioner, Santa Paula, Cal.

In December, 1910, E. O. Essig published a description of a new mealy bug, to which he gave the name *Pseudococcus bakeri.* Because of its habit of feeding on the walnut trees in Ventura County it was given the common name of walnut mealy bug. Since that time the writer has collected additional specimens and data regarding the distribution of this insect which may prove of interest.

The known host plant list at present is as follows: Walnut, apple, pear, orange, lemon, pomelo, elder, cottonwood, southern California black walnut, nightshade and a few of the ornamental shrubs. It has been found in three localities in Ventura County infesting citrus trees, but in two of these cases it occurs in much greater numbers on the native elder and nightshade surrounding the trees. For at least a portion of the year it lives primarily on the roots of these two plants. Numerous solanum bushes growing under orange trees have been found with the roots thickly covered with all stages, from eggs to mature adults. The same has been true of the elder, though so far no specimens have been reported on roots of citrus or other fruit trees.

The life history appears to be much the same as that of *Pseudococcus citri* with this decided difference: the egg masses are much looser and the number of eggs laid by a single female is much less. This is quite a factor in the control of the insect, as it appears to have been present in certain orchards for a good many years without at any time becoming a damaging pest. Mr. J. J. Davis, in the *Entomological News,* XIX, No. 8 (1908), gives the average eggs of *Pseudococcus citri,* per mass counted, as 274 (twenty masses counted). Essig states, in commenting on this count, that under field conditions around Santa Paula (1909), the average was undoubtedly somewhat higher than this, reaching at least five hundred eggs for some individuals. He further states (P. C. Jr. Ent. II, No. 4) that practically all eggs of *Pseudococcus citri* seem to be fertile. The writer has counted the eggs in ten masses of *Pseudococcus bakeri* with a range from forty-two to a hundred and sixteen, and an average of sixty-seven eggs. In confinement in glass jars these appeared to be from ten per cent to twenty per cent unfertile. This may not hold true under field conditions, but we have observed in numerous old egg masses a few shriveled eggs unhatched. We have also seen appearances which lead us to believe that egg parasites play a considerable part in the control, but, so far, we have been unable to rear any.

From all observations to date we do not feel that *Pseudococcus bakeri* will ever properly be classed as a damaging insect, as it seems to require no additional control measures. We have not seen it in sufficient numbers to smut more than a very small percentage of the fruit nor have we seen it to have any noticeable effect on the health of the plant. Carbolic acid emulsion and other sprays which are effective against *Pseudococcus citri* are equally so against *Pseudococcus bakeri,* and fumigation seems much more efficient against the latter than the former species.

THE CORN WORM.

(*Heliothis obsoleta Hübn.*)

Order—Lepidoptera. **Family—Noctuidæ.**

By A. J. Cook, State Commissioner of Horticulture, Sacramento, Cal.

The corn worm, often known as corn-ear worm, less frequently as tomato worm, and again as cotton-boll worm (*Heliothis obsoleta*), is a serious pest in all parts of California. The moth lays the ribbed egg in spring. The pink, often darker, caterpillar—"worm"—enters at the silk end of the ear, and feeds on the growing kernels, causing pronounced furrows, and soiling the ear with its repulsive excrement. It feeds for near a month and reaches one and one half inches in length, when it enters the earth and pupates in an earthen cocoon, lined loosely with fine silk. The pupa is green at first, but soon becomes a bright brown. The moth which comes in a short time, in case of the summer brood, from the pupa varies in color and markings. It is generally yellowish or grayish and expands nearly two inches. Unlike most moths of the family *Noctuidæ,* it flies by day. There is a summer and an autumn brood.

As suggested in the common names, it feeds on the cotton-boll, the corn ears and the tomato fruits, though it eats sparingly of the leaves and stems, into which it bores. It is partial to corn, especially sweet corn, hence a remedy for the tomato gardener: By planting rows of sweet corn among the tomatoes, every tenth row should be corn, the moth is attracted from the less inviting tomato plants. The fondness of this insect for sweet corn attracts it to this plant, and the tomatoes escape. By dusting the silk of the corn with lead arsenate, or spraying with the same in water, two pounds to fifty gallons, we poison the caterpillar and save the corn. I have known the corn to be saved by careful hand picking. This in the garden, in a small way, is quite satisfactory.

NEMATODE WORMS AND MOTTLED LEAF.

By J. R. Hodges, Horticultural Inspector, Covina, Cal.

Having obtained consent of Mr. A. R. Meserve over a year ago to make an investigation of mottled leaf of citrus trees, I commenced making a careful microscopic examination of the leaves, branches, bark, wood and finally the soil and roots of diseased trees. My examination was largely confined to trees badly enough affected with mottled leaf as to interfere with the proper ripening of the fruit, making what is called "small offs" in the packing-house. After examining a great many trees on different kinds of soil, I noticed that there was one condition common to all trees badly affected with mottled leaf: an imperfect condition in the fibrous root system, sometimes amounting to a great scarcity of fibrous roots which were broken down, scarred and in various stages of decay. At first I found, under the microscope, only parts of the nematodes, a head here and a tail there, but later, by scraping the rootlets while submerged in water, I found live, actively moving specimens, in many cases very numerous on badly decayed roots. I have obtained as many as fifty specimens from four pieces of fibrous roots, the size and length of a common pin. It seemed to me that if this condition existed throughout the fibrous root system it would be sufficient burden on the tree to cause yellowing of the leaf irrespective of other influences that might be at work on the tree.

I reported the matter to Mr. Meserve, and later to Mr. William Wood, the present horticultural commissioner of Los Angeles County, who encouraged me to go on with the work. I have at various times reported the work to professional horticulturists, from whom very little encouragement has been received, until Mr. E. E. Thomas[1], of the Whittier Laboratory, followed up the matter and published a circular on the subject. I wish to thank Mr. Thomas for his interest in the matter, notwithstanding the fact that the problem will be worth very little to me, but might be worth something to him.

I believe that nematodes often infest the roots of nursery stock that are transplanted in the orchard and that they spread from one tree to another in the irrigation and storm water. I have kept these nematode worms for eight days in water without apparent injury. In badly infested orchards they appear to infest the roots of the vetch, malva and other weeds, sometimes to the extent of killing out the vetch and malva. They apparently make little headway on the alfilaria.

I have had some success in treating affected trees with carbon bisulphide. The best results were obtained by making shallow holes about two inches deep, one foot apart each way, and putting about three fourths of an ounce of carbon bisulphide in each hole and covering the ground with an impervious tent or cloth and allowing it to remain for about forty-eight hours before removal. After treating the ground with this dosage no live nematodes could be found. Just how much smaller dosage could be used with success I do not know. Trees treated with greater amounts than this showed injury and lost their leaves. After treating, the ground was covered with a mulch of barnyard manure, about one inch thick, which kept up an even moisture content of about ten per cent during the season following. The trees now show a normal condition of fibrous roots, but are not entirely free from the nematode. The pest, however, is so far eliminated that the trees are doing well.

I think that mottled leaf and the "small off" is due to the large numbers of the pest that infests the roots. Just as with other pests, as for example the red spider, a small number will do no apparent injury, while a large increase in numbers will cut down the productiveness of the tree to a great extent.

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[1] A preliminary report of a nematode observed on citrus roots and its possible relation with the mottled appearance of citrus trees.—Circular 85, Cal. Agrcl. Exp. Station, Feb., 1913.

THE USE OF FLOUR PASTE IN LIME-SULPHUR SOLUTIONS IN THE CONTROL OF THE CITRUS RED SPIDER.

By J. D. Neüls, Expert, U. S. Dept. of Agriculture, El Centro, Cal.

At the writer's suggestion, a few tests, using commercial lime-sulphur with the addition of flour paste made according to the directions in Circular No. 166 of the Bureau of Entomology by Mr. W. B. Parker, were made by Mr. Sweigert, the inspector at Whittier, against the citrus red spider (*Tetranychus mytilaspidis*). In all the plots treated, a few trees were sprayed with lime-sulphur solution without the flour paste added, as a check. Although the experiments were few and owing to the departure of the writer to other fields, were not carried through to the desired completion, the results were so satisfactory that the writer was requested by Mr. Essig to publish a brief account of the results.

No difficulty was encountered in picking out the trees that were sprayed with the lime-sulphur alone. The spotting of the leaves and fruit, familiar to all who have had occasion to use the lime-sulphur solution, was not to be found on the trees where the flour paste had been added. So even was the distribution that only by a close examination could one tell that the tree had been treated. Conversation with the sprayer brought out the fact that hereafter, even if the grower refused to sanction the small additional expense of the flour paste, the sprayer would add it himself because the pumps worked much better. There was no clogging either in the pumps or at the nozzle and a two hundred gallon tank of the spray with the flour paste added would cover more trees than with the lime-sulphur alone.

The chief objection to the lime-sulphur solution has been that it spotted the fruit, particularly oranges, necessitating washing. These experiments point to the fact that with the additional flour paste the washing of the fruit may not be necessary. The distribution of the lime-sulphur is so even when the flour paste is added that it spreads over the surface of the leaves and fruit in a thin film so that very little spotting occurs. The few spots that do occur and which are generally formed where the solution drops off the leaves or fruit, are of such a character (because of the flour paste) that they dry and crack, so that if they do not fall off of their own accord in the field they are very easily brushed or rubbed off in picking. It was the intention of the writer to follow up the fruit that had been sprayed with the lime-sulphur and flour paste to the packing-house to see whether or not it had to be washed, but circumstances prevented.

The effectiveness of the commercial lime-sulphur solution with the flour paste added in the right proportion is increased owing solely to the fact that the distribution is much greater. The insecticidal value of the lime-sulphur solution against red spiders is the best known of any remedy and the addition of the flour paste seems to bring this solution to the highest point of efficiency.

The purpose of this article is to bring these points and suggestions before the minds of those interested in the control of the citrus red spider with the hope that it may stimulate others to experiment along this line and thus develop a thorough and efficient method in controlling this serious pest.

FISKE AND THE GYPSY MOTH.

By HARRY S. SMITH, Superintendent State Insectary, Sacramento, Cal.

The Federal Bureau of Entomology has recently issued a circular, No. 164, entitled "The Gypsy Moth as a Forest Insect, With Suggestions as to Its Control." This article by W. F. Fiske, the foremost authority on natural control of insects, will cause all lovers of trees, especially those in New England, to breathe a bit easier. The gypsy moth is no longer the dreaded pest of 1896 to 1900. While it is still a vital factor in American forestry, wholesale devastation, not only of all forest trees, but of fruit and shade trees and even gardens and fields, is a condition which no longer prevails. The situation with regard to this insect has become greatly improved within recent years.

This improvement of conditions is said to be due to four main causes: (1) The perfection and standardization of the methods of artificial repression; (2) the death of a large proportion of the more susceptible trees or their removal from the infested woodlands; (3) the importation of parasitic and predatory insect enemies; and (4) the development of the "wilt" disease.

California parasite enthusiasts have watched with considerable interest the attempt to introduce the natural enemies of the gypsy moth into New England. They will then be much interested in what Mr. Fiske has to say with regard to the progress of this work. He writes as follows:

"There are about thirty species of insect enemies of the gypsy moth which appear to be of importance in checking its increase in Europe and Japan. All of the promising species have been imported and colonized under more or less satisfactory conditions in America. Not all have successfully accommodated themselves to their new environment. About one third of the total appear to have done so and to be steadily increasing in efficiency in accordance with their powers of multiplication and dispersion.

"It was hoped that more of them would acclimatize themselves; it was feared that the number might be less. On the whole, the results are decidedly satisfying, and the State of Massachusetts and the United States Department of Agriculture have no cause to regret having undertaken the unexpectedly formidable task of parasite importation. Within a territory centering a little to the northward of Boston, it may be conservatively stated that fully fifty per cent of the eggs, caterpillars, or pupæ of the gypsy moth, in the aggregate, were destroyed by imported parasites in 1912."

Owing to the great expense attached to the use of artificial means of control, such as spraying, these methods are available only on shade trees and in parks. In the infested New England forests the bacterial or "wilt" disease and the insect enemies constitute the factors upon which the authorities mainly rely for repression. Of these Mr. Fiske states that—"More than to the parasites, more than to the perfection of the methods of artificial suppression, the amelioration in conditions is due to the 'wilt' disease." This malady is of bacterial origin and is apparently similar to the flacherie of the silkworm. It first appeared in New England in 1903 or 1904. By 1911 it reached its climax and was everywhere in evidence. A peculiar fact noted by Mr. Fiske, with regard to this disease, is that strangely enough its virulence is greatly augmented when the caterpillars feed upon certain species of trees and shrubs, and for that reason these trees are practically resistant to the gypsy moth attack. The great importance attached to this discovery is obvious.

Mr. Fiske has spent a large part of the past four years abroad in the study of the gypsy moth, paying especial attention to its control through natural factors. He also investigated carefully the effect upon the moth's abundance of certain types of forests and forest management. His study in Europe, added to by extensive experiments carried on in this country under the direction of A. F. Burgess of the United States Department of Agriculture and Doctor Wheeler of Harvard, has thrown great light upon the subject of resistance of various types of forests to the moth through the agency of the "wilt."

In brief it has been found that upon certain trees, principally the oaks and birches, the moth increases rapidly to the point of complete defoliation. Upon certain other trees, when growing alone, it rarely increases to the point of defoliation, and usually is barely able to hold its own. This latter group includes the conifers, some poplars, chestnut, hickory, sycamore, elm, catalpa, ash, locust, maple and several others. These trees are spoken of as being resistant to the gypsy moth through the operations of the "wilt" disease.

With regard to the practical application of this valuable information, Mr. Fiske has the following to say:

"There are, therefore, two phases of the complex problem of gypsy moth control in forests which must be considered. First, how best to eliminate the oak and secure its replacement by other, and, if possible, more valuable trees; and, second, how best to protect the oak from serious injury in localities where little else can be grown to advantage.

"In a large portion of the area at present infested by the gypsy moth the solution is almost absurdly simple. This is the natural home of the white pine, one of the most valuable timber trees to be found in the whole temperate zone. In a way the oak is an interloper. Over a large part of New England the white pine was once preeminent, and it would become so again were the country to be deserted by civilized man. The pine reproduces freely, if given half a chance, but there are thousands of acres in the aggregate in which a natural reproduction of pine is being retarded, destroyed even, through the mere circumstance that the oak chanced to secure a running start, by sprouting when the land was last cut over. The German forester who would permit such conditions to prevail would be considered hopelessly, even criminally, insane. Under such circumstances oak is to be considered as a weed, and the advent of the gypsy moth as a blessing when, as sometimes happens, it takes the oak and leaves the pine. If it would always do just that and nothing more its progress might be watched with a certain degree of complacency. But it does not always stop at that, and, what is worse, injudicious cutting not infrequently results in greater damage than would be done by the gypsy moth itself. The larger pines are apt to be cut or broken down, and the smaller ones, unable to compete with the rapidly growing oak sprouts, are quickly in no better condition than before.

"The natural program, therefore, in every pine and oak mixture, is so to eliminate the oak as to afford the pine a better opportunity to take possession of the ground. How this may best be accomplished depends entirely upon the individual characteristics of any particular wood lot. And, furthermore, it is strictly a problem in applied forestry and one for the forester, not for the entomologist, to solve."

To those who have witnessed the devastation of the New England forests through the gypsy moth during the past twelve years, Mr. Fiske's message will be most welcome. While in the light of the work done the remedy seems simple enough, the idea is a big one, really the result of genius, and the Bureau of Entomology is to be congratulated on having placed so able a man as Fiske on this important work.

TEAR STAINING OF LEMONS.

(Due to the fungus *Colletotrichum glœosporioides* Penz.)

By H. S. FAWCETT, Plant Pathologist, State Commission of Horticulture, Whittier, California.

A faint, reddish stain has often been noticed on lemons, as if formed in a drop of dew, or as if a drop of water had run down over the surface of the fruit, leaving infection in its track. It sometimes covers a large part of the fruit. Usually this stain only slightly injures the appearance of the fruit, but since it is set in the surface of the rind and cannot be washed off it is sometimes troublesome.

This faint staining of the surface is not to be confused with "red rot" (see Fig. 57, Bul. 218, California Experiment Station), in which a large area on one side is highly colored and somewhat hard and shrunken, nor with "red spot," a reddish pitting in which small red sunken pits are formed. (See description and Fig. 18 by E. O. Essig, in Pomona College Journal of Economic Botany, Vol. I, page 33, and see also illustration in California Plant Diseases, Bul. 218, Fig. 55, California Experiment Station.) Considerable doubt has existed as to whether the faint, reddish discoloration on lemons in California, known as tear stain, was due to the same cause as the tear stain of Florida fruits attributed by P. H. Rolfs to the wither tip fungus *Colletotrichum glœosporioides*.

Some recent experiments by the writer indicate that it is the same. The results of the experiments are also confirmed in an unpublished manuscript report by C. N. Jensen in 1910 at the Whittier Laboratory, that a reddish stain of this kind can be produced on uninjured lemons in California with spores of this fungus. Lisbon lemons of various ages were picked and placed at once into a glass jar on March 14, 1913. The spores from a culture of wither tip fungus isolated from a lemon tree at Santa Paula were shaken up in water and poured over these fruits. The jar was then covered to keep the fruit moist. In two weeks the faint reddish stains in blotches and in lines where the water with spores had run down were quite prominent. In four weeks they were still more pronounced. They appeared to develop on green, half-grown fruit, as well as on mature fruit. Other fruits picked at the same time and kept in a moist jar without the application of the spores failed to develop these stains. A microscopic examination of the stained areas showed the characteristic appressoria or contact pads of the wither tip fungus. These seemed to be confined almost entirely to the stained areas. The stain appeared to be due to cells that had been discolored by the presence of the fungus. In some cases hyphæ could be made out under the microscope, apparently just partly imbedded in the surface cells and so connected with these contact pads as to belong evidently to the same fungus. Some lemons in a second jar were very minutely punctured over small areas with a needle on which numerous spores of wither tip fungus were clinging. In two weeks a slightly sunken area with broken-down cells and a reddish stain was evident. Other fruits punctured in the same way without spores being present on the needle showed a slightly sunken area with nearly as many broken down cells as in the others, but the red stain was absent. These experiments seem to prove that the wither tip fungus is at least one of the causes for tear staining of lemons in California and may cause reddening of slightly injured places.

As the spores of this fungus are common in dead twigs or limbs that have died from any cause, it is important to keep these cut out as much as possible. The drip from dews or rains is thought to be the principal cause for the tear staining. It may be mentioned here that there is sometimes a faint staining of the fruit merely due to dirt and dust washing down over the fruit and which can be rubbed off easily. This is not normal ''tear staining.''

Tear staining may also be prevented by spraying with a good fungicide. Lime-sulphur solution, Bordeaux mixture, or ammoniacal solution of copper carbonate may be used. The disadvantage of Bordeaux mixture is that when followed within a few weeks or months by fumigation for insects, it is apt to cause defoliation. Lime-sulphur solution is suggested as the best when all things are considered, since it is also useful in controlling the red spider.

GENERAL NOTES.

ROOT-KNOT.

We are getting specimens of root-knot from many vegetables, shrubs and trees. As is well known this is a nematoid affection, being produced by the nematoid worm, *Heterodera radicicola.* It attacks very many weeds as well as our cultivated plants. It attacks potatoes in several counties of the State. In receiving nursery stock or ornamental plants from outside the State or in intercounty shipments, we should refuse any specimens that show this disease. Rotation of crops has special significance in view of this affection. We are studying to know what plants are immune, if such there be, to know what to plant in infected soil. In the case of this malady, as with the bacterial affection, known as crown gall, trees or shrubs badly diseased may well be uprooted and destroyed. I doubt if any plant ailment in our State is more common than this root-knot.—A. J. COOK.

LIME-SULPHUR.

There are two reasons why we regard this solution with exceptional interest. I believe it originated in California, and it is a very excellent specific against many pests—insect and fungoid. We may often use it at a time when it will work the destruction of two or more serious enemies to our fruit trees and shrubs. The terrible pernicious scale, *Aspidiotus perniciosus,* yields to this solution, as to no other known remedy. In this case it is used as a winter spray and does no harm to the defoliated trees. Sulphur alone is often a sure preventive of the work of the mites usually called spiders, as the red spider. Many fungi yield to the lime-sulphur solution, as curl leaf in the peach and the various mildews. Thus lime-sulphur solution is both a fungicide and an insecticide. It is comparable to Bordeaux, and these two are the sovereign remedies for fungoid diseases.

One of the most common and most destructive pests known to the gardener and fruit grower is the mite, or "spider," of which there are several species, as the pear blister mite which deforms and injures pear foliage and blisters the pear itself. This and the related silver mite are very minute. It is more than probable that a close study would determine that both of these affections could be controlled by the use of the lime-sulphur solution. In all cases of blights, a trial should be made first of lime-sulphur, as the cheaper, and then of the Bordeaux.

Sulphur alone dusted on the foliage is often a very satisfactory specific against mildews and mites. Here the heat of the sun produces fumes from the powdered sulphur. In cool or cloudy weather these fumes are often not enough in evidence to produce results, in which case the lime-sulphur solution may be very effective.—A. J. COOK.

SULPHURING FOR MILDEW.

Some roses are especially susceptible to mildew attack. As in the case of the grape, powdered sulphur if applied in season will usually prevent this blighting mildew from injuring the shrubs. These mildews are always more severe in times of fogs and a damp atmosphere. The crimson rambler and Marie Henriette roses are especially liable to attack. To work a sure cure, the sulphuring must be done early before the mildew attacks the plants. However, it will do good later as the new foliage that starts after the diseased leaves fall will be saved from affection. The spores, seeds of the fungus—if we may so speak—are killed by the sulphur, while the fungus if started is immune.

In advising, I have usually suggested that the first sulphuring should be done at the same time that the winter cover crop is to be plowed under in February. Thus, the house wife as she applies the sulphur to her scarlet rambler will remind the "Gude Man" of the house that it is time to turn under his vetch, or *vice versa.*—A. J. COOK.

PEAR-LEAF BLISTER-MITE ATTACKING FRUIT.

The pear-leaf blister-mite, *Eriophyes pyri* Pgst., is quite abundant in the central and northern parts of the State and its work upon the leaves is familiar to all. It is not, however, generally known that this mite also attacks the fruit. Considerable damage is being done to the young pears this year. Mr. J. E. Hassler, county horticultural commissioner of El Dorado County, sent in the first affected fruit with the statement that much of the young fruit was affected. Later specimens were sent in by Commissioner D. F. Norton of Nevada County.

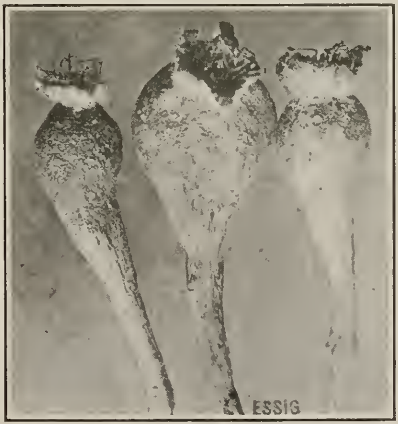

FIG. 333.—Work of the pear-leaf blister-mite, *Eriophyes pyri* Pgst., on fruit. (Original.)

The work upon the fruit greatly resembles that upon the leaves. There appear small chafed areas which enlarge and later appear as distinct rings with reddish or dark border and lighter sunken center.

In badly infested cases the rings merge into one another, forming a very scabby-looking blotch. The illustration shows this clearly, but does not show the rings, because of the lack of contrast between the light-red and rose-tinted fruit.

Mr. Hassler informs the writer that the mite is very difficult to control on the fruit and after two years' experience believes that a lime spray composed of from twelve to fourteen pounds of lime to forty gallons of water is superior to a lime-sulphur spray.

In treating the mite during the winter he has found the addition of lime to the commercial lime-sulphur solution decidedly helpful.—E. O. Essig.

UNIVERSITY OF CALIFORNIA JOURNAL OF AGRICULTURE.

We are very glad to announce the appearance of the above publication which is certainly a credit to those who are behind it. The first issue, Vol. I, No. 1, appeared this month and contains the following leading articles:

Selective Immigration	Dean Hunt
Soil Surveys in California	Prof. C. F. Shaw
What the Agricultural Experiment Station Hog Serum Laboratory is Doing for California Hog Raisers	Prof. C. M. Haring
Frost Fighting on the Limoneira Ranch	Carl Nichols
The Spirit of Co-operation	Wm. McNaught
The Cotton Outlook in Imperial Valley	W. E. Packard

It is pushed by the students in the College of Agriculture under the editorship of Mr. H. H. Warner.—Editor.

MONTHLY CROP REPORT—MAY.

These data are compiled by the secretary from monthly crop reports made by the county horticultural commissioners. Counties not included have not reported or the reports have come too late for press. Unless otherwise designated percentages refer to last year's crop.

Alfalfa.

Colusa—120 per cent of last year's crop of 200,000 tons. *Glenn*—Average of 1½ tons per acre where irrigated. *Inyo*—Full crop of 110,000 tons. *Kern*—Normal crop of 25,000 tons. *Lake*—Normal. *Los Angeles*—Full crop of 113,062 tons; a somewhat cold spring has shortened the alfalfa season, but increased acreage will bring up the total crop. *Madera*—125 per cent of last year's crop, 18,250 acres. *Mendocino*—Full crop. *Monterey*—25 per cent more than last year. *Nevada*—Full crop. *Orange*—Full crop. *Sacramento*—90 per cent of last year's. *San Benito*—Normal. *San Diego*—Crop at least 10 per cent better than last year's. *Siskiyou*—Excellent crop; 30 per cent more planted than last year. *Solano*—10 per cent more than last year's crop, there being plenty of water in the alfalfa regions. *Sonoma*—90 per cent of last year's crop of 3,500,000 pounds. *Stanislaus*—10 per cent more than crop of last year; 120,000 acres in bearing; first cutting one ton to acre. *Tehama*—Full crop. *Tulare*—75 per cent of normal crop. *Yolo*—10 per cent increase over last year's. *Yuba*—Full crop of 7,500 tons.

Crop to be much larger than that of last year.

Almonds.

Alameda—Crop in fine condition, promises to exceed last season's crop by 50 per cent. *Butte*—25 per cent of crop. *Contra Costa*—25 per cent of last year's crop of 250 tons; due to frost. *Glenn*—75 per cent. *Lake*—10 per cent. *Los Angeles*—75 per cent of last year's crop of 57,770 pounds. *Madera*—100 per cent. *Nevada*—Only 10 per cent of last year's crop of 12,000 pounds; early bloom was killed by frost. *Placer*—25 per cent. *Riverside*—90 per cent. *Sacramento*—One third of full crop. *San Benito*—100 per cent. *San Bernardino*—Caught by frost, no crop. *San Joaquin*—Almost failure. *Solano*—65 per cent of last year's crop. *Sonoma*—Same as last year's crop. *Stanislaus*—5 per cent of last year's crop of 240,000 pounds. *Sutter*—Half crop. *Tehama*—25 per cent of last year's crop of 200,000 pounds. *Ventura*—75 per cent of last year's crop; only small acreage in almonds. *Yolo*—Nonpariel and Drake's seedling 95 per cent of last year's crop. Texas prolific, Ne Plus Ultra, IXL 30 per cent.

Almonds will be very short this year but are looking better than at time of last report.

Apples.

Butte—80 per cent. *El Dorado*—40 per cent. *Fresno*—80,000 pounds. *Glenn*—75 per cent. *Inyo*—75 per cent of last year's crop of 1,250,000 pounds. *Kern*—100 per cent. *Lake*—25 per cent of last year's crop which was 50 per cent above normal. *Los Angeles*—6,221,250 pounds. *Mendocino*—50 per cent. *Nevada*—40 per cent of last year's crop of 7,000,000 pounds. *Monterey*—40 per cent to 50 per cent. *Orange*—115 per cent. *Placer*—Fair crop, little early for estimate. *Riverside*—85 per cent. *Sacramento*—75 per cent. *San Benito*—50 per cent. *San Bernardino*—95 per cent. *San Diego*—85 per cent. *San Joaquin*—Good crop. *Santa Barbara*—7,521,325 pounds. *Santa Clara*—70 per cent. *Santa Cruz*—1,000 to 1,500 carloads for valley; perhaps 2,000 carloads for county. *Siskiyou*—Fair crop. *Sonoma*—75 per cent of last year's crop of 13,500,000 pounds. *Stanislaus*—75 per cent of last year's crop of 112,500 pounds. *Tehama*—24,000 pounds. *Tulare*—65 per cent. *Yuba*—80 per cent of last year's crop of 100 tons.

Though not normal a fair crop is assured.

Apricots.

Alameda—50 per cent. *Butte*—30 per cent. *Contra Costa*—60 per cent. *Fresno*—25 per cent of last year's crop of 50,000 pounds. *Glenn*—50 per cent. *Inyo*—Normal. *Kern*—80 per cent. *Kings*—35 per cent. *Lake*—25 per cent. *Los Angeles*—90 per cent of last year's crop of 7,250,000 pounds. *Madera*—25 per cent. *Monterey*—200 per cent. *Nevada*—15 per cent of last year's crop of 10,000 pounds. *Orange*—Crop is 50 per cent of last year's, but only 25 per cent of normal. *Placer*—60 per cent. *Riverside*—100 per cent. *Sacramento*—75 per cent. *San Benito*—65 per cent. *San Bernardino*—80 per cent. *San Joaquin*—With few exceptions a failure. *Santa Barbara*—1,495,921 pounds. *Santa Clara*—50 per cent. *Santa Cruz*—100 per cent. *Solano*—100 per cent. *Sonoma*—500,000 pounds. *Stanislaus*—10 per cent of last year's crop of 100,000 pounds. *Sutter*—100 per cent. *Tehama*—50 per cent of last year's crop of 1,000,000 pounds. *Tulare*—20 per cent *Ventura*—40 per cent of last year's crop of 2,400 tons dried. *Yolo*—40 per cent. *Yuba*—80 per cent of last year's crop of 20 tons.

The apricot crop will be short, varying from one half to three fourths of last year's crop.

Beans.

Los Angeles—90 per cent of last year's crop of 5,775,000 pounds. *Monterey*—100 per cent. *Sacramento*—48,000,000 pounds. *Siskiyou*—Fair crop. *Sonoma*—250,000 pounds. *Stanislaus*—50 per cent of last year's crop of 720,000 pounds. *Ventura*—65,000,000 pounds, more limas planted than ever before.

A good crop of beans is expected throughout the State.

Berries.

Glenn—Full crop. *Kern*—100 per cent. *Kings*—Normal crop. *Los Angeles*—100 per cent. *Mendocino*—50 per cent. *Monterey*—70 per cent. *Nevada*—50,000 pounds. *Orange*—100 per cent. *Sacramento*—100 per cent. *Santa Clara*—Good. *Santa Cruz*—Over normal. *Siskiyou*—100 per cent. *Sonoma*—95 per cent of last year's crop of 1,000,000 pounds which was unusually large. *Stanislaus*—100,000 pounds.

Berries will make a good crop throughout the State.

Cherries.

Alameda—45 per cent. *Butte*—100 per cent. *Contra Costa*—70 per cent. *El Dorado*—40 per cent. *Glenn*—80 per cent. *Kings*—100 per cent. *Los Angeles*—100 per cent. *Mendocino*—50 per cent. *Monterey*—50 per cent. *Nevada*—30 per cent. *Placer*—70 per cent. *Riverside*—85 per cent of full crop. *Sacramento*—100 per cent. *San Benito*—50 per cent. *San Bernardino*—80 per cent of full crop. *San Joaquin*—25 per cent. *Santa Barbara*—102 per cent. *Siskiyou*—100 per cent. *Santa Clara*—50 per cent. *Santa Cruz*—100 per cent. *Solano*—80 per cent. *Sonoma*—65 per cent of last year's crop of 3,000,000 pounds, which was unusually large. *Stanislaus*—14,000 pounds. *Sutter*—75 per cent.

Harvesting has commenced in the valleys, and though the crop is short, prices are making up for a normal year.

Figs.

Butte—100 per cent. *Fresno*—100,000,000 pounds. *Glenn*—50 per cent. *Los Angeles*—97,376 pounds. *Madera*—Looks like 100 per cent. *Nevada*—75 per cent of last year's crop of 68,000 pounds. *Sacramento*—100 per cent. *Solano*—100 per cent. *Stanislaus*—80,000 pounds. *Tulare*—75 per cent. *Yolo*—100 per cent. *Yuba*—10 tons dried.

A big crop is apparently assured throughout the State.

Grapes (Wine).

Contra Costa—50 per cent. *El Dorado*—70 per cent. *Fresno*—180,000,000 pounds. *Kern*—100 per cent. *Kings*—Crop will probably be affected by dry weather; estimate too early. *Lake* 100 per cent. *Madera*—100 per cent. *Mendocino*—50 per cent. *Nevada*—3,000,000 pounds. *Placer*—Good crop. *Riverside*—100 per cent. *Sacramento*—100 per cent. *San Bernardino*—95 per cent of full crop. *Shasta*—Fair. *Solano*—Too early for estimate. *Sonoma*—65,000,000 pounds. *Stanislaus*—4,000,000 pounds. *Sutter*—Too early for estimate. *Tehama*—1,600,000 pounds. *Tulare*—Outlook good, but too early for estimate. *Yolo*—Good bloom. *Yuba*—400 tons.

There are prospects for a good crop of wine grapes, though it is yet a little early to make a definite estimate.

Grapes (Table).

Contra Costa—65 per cent. *Fresno*—Equal to last year's crop of 10,000,000 pounds. *Glenn*—100 per cent. *Inyo*—Crop of 350,000 pounds. *Kern*—100 per cent. *Los Angeles*—Equal to last year's crop of 33,634,730 pounds. *Madera*—Looks like full crop, little early. *Mendocino*—50 per cent. *Monterey*—Looks good. *Nevada*—Equal to last year's crop of 1,500,000 pounds. *Placer*—Better than was expected. *Sacramento*—100 per cent. *San Bernardino*—95 per cent of full crop. *San Joaquin*—Appearances indicate fine crop; contracts being let for $25 a ton. *Shasta*—Looks good. *Siskiyou*—Excellent crop. *Solano*—90 per cent. *Sonoma*—Full crop of 500,000 pounds. *Stanislaus*—Equal to last year's crop of 3,000,000 pounds. *Sutter*—Heavy bloom. *Yolo*—Good prospects. *Yuba*—Crop of 200 tons.

Good crop expected throughout the State.

Hops.

Lake—100 per cent. *Mendocino*—Too early for estimate. *Sacramento*—100 per cent. *Sonoma*—Equal to last year's crop of 4,500,000 pounds. *Yuba*—Crop of 700 tons baled.

A little early for reliable estimates, but prospects are good.

Lemons.

Glenn—Full crop set. *Los Angeles*—10 per cent of last year's crop of 59,151,284 pounds, due to January frost. *Nevada*—Crop a failure, due to frost; only a few boxes. *Orange*—50 per cent, due to frost. *Riverside*—50 per cent of crop. *Sacramento*—100 per cent. *San Bernardino*—40 per cent of full crop, due to frost. *San Diego*—15 per cent, due to frost. *Santa Barbara*—98 per cent of last year's crop of 3,146,850 pounds. *Stanislaus*—Just in bloom. *Tehama*—Equal to last year's crop of 20,000 pounds. *Tulare*—Too early for estimate. *Ventura*—Normal crop of 565 cars.

Very small output is expected.

Olives.

Fresno—Equal to last year's crop of 15,000,000 pounds. *Glenn*—Now in full bloom. *Los Angeles*—Crop estimated to be double last year's crop of 387,500 pounds. *Madera*—Good prospects. *Nevada*—Too early for estimate. *Placer*—60 per cent. *Riverside*—100 per cent. *Sacramento*—100 per cent. *San Bernardino*—90 per cent. *Santa Barbara*—Crop of 623,136 pounds. *Sonoma*—Equal to last year's crop of 650,000 pounds. *Stanislaus*—Too early. *Tehama*—Crop estimated at 1,000,000 pounds. *Tulare*—85 per cent.

A good crop of olives is promised.

Oranges.

Colusa—Good setting. *Fresno*—Equal to last year's crop of 5,000,000 pounds. *Glenn*—100 per cent. *Kern*—Good. *Los Angeles*—50 per cent more than last year's crop of 44,550,000 pounds. *Nevada*—400 boxes. *Orange*—90 per cent. *Placer*—70 per cent, small acreage. *Riverside*—60 per cent. *Sacramento*—100 per cent. *San*

Bernardino—60 per cent. *San Diego*—40 per cent. *Santa Barbara*—100 per cent. *Sonoma*—50 per cent. *Tehama*—150,000 pounds. *Tulare*—Too early for estimate. *Ventura*—430 cars.

The crop south will be unusually short because of frost. It will be better in the north.

Peaches.

Alameda—65 per cent. Curl leaf bad. *Butte*—Good. *Contra Costa*—65 per cent. *El Dorado*—50 per cent of full crop. *Fresno*—70 per cent of last year's crop of 30,000,000 pounds. *Glenn*—80 per cent. *Kern*—85 per cent. *Kings*—Normal. *Lake*—25 per cent. *Los Angeles*—10,321,575 pounds. *Madera*—95 per cent. *Mendocino*—25 per cent. *Monterey*—100 per cent. *Nevada*—60 per cent. *Orange*—200 per cent. *Placer*—70 per cent. *Riverside*—100 per cent. *Sacramento*—100 per cent. *San Benito*—75 per cent. *San Bernardino*—90 per cent. *San Diego*—100 per cent. *San Joaquin*—Muirs set well, Albertas about 75 per cent. *Santa Clara*—40 per cent. *Shasta*—Upland crop variable but not full; lowlands nothing. *Sonoma*—55 per cent. *Stanislaus*—35 per cent of last year's crop of 7,500,000 pounds. *Sutter*—Clings 100 per cent, Muirs 75 per cent. *Tehama*—50 per cent of last year's crop of 25,000,000 pounds. *Tulare*—Freestones 60 per cent of normal crop; clings 35 per cent of normal crop. *Yolo*—Prospects for normal crop. *Yuba*—70 per cent of last year's crop of 500 tons.

Peach crop exceedingly variable, but much below that of last year.

Pears.

Alameda—Bartletts have set well and show little scab; other varieties are dropping their fruit somewhat; estimated crop 75 per cent. *Butte*—25 per cent. *Contra Costa*—55 per cent. *El Dorado*—50 per cent of last year's crop. *Glenn*—80 per cent. *Inyo*—Equal to last year's crop of 600,000 pounds. *Kings*—Normal. *Kern*—100 per cent. *Lake*—50 per cent. *Los Angeles*—Equal to last year's crop of 931,150. *Mendocino*—25 per cent. *Monterey*—75 per cent. *Nevada*—40 per cent of last year's crop of 5,760,000 pounds. *Orange*—35 per cent more than last year. *Placer*—90 per cent. *Riverside*—80 per cent *Sacramento*—75 per cent. *San Benito*—75 per cent. *San Bernardino*—Full crop, but few grown. *San Joaquin*—Good. *Santa Clara*—60 per cent. *Shasta*—Light. *Siskiyou*—Good. *Solano*—100 per cent. *Sonoma*—60 per cent of last year's crop, which was unusually large, being 4,500,000 pounds. *Stanislaus*—50 per cent of last year's crop of 260,000 pounds. *Tehama*—10 per cent. *Yolo*—Prospects for good crop. *Yuba*—70 per cent of last year's crop of 1,300 tons.

The pear crop will be considerably less than last year's.

Plums (Shipping).

Butte—90 per cent. *Contra Costa*—100 per cent. *El Dorado*—35 per cent. *Fresno*—10,000 pounds. *Kern*—90 per cent. *Los Angeles*—1,734,700 pounds. *Monterey*—60 per cent. *Nevada*—50 per cent. *Orange*—100 per cent. *Placer*—70 per cent. *Sacramento*—80 per cent. *San Joaquin*—100 per cent. *San Bernardino*—90 per cent; few grown. *Solano*—100 per cent. *Sonoma*—55 per cent. *Stanislaus*—35 per cent of last year's crop of 15,000 pounds. *Sutter*—100 per cent. *Tehama*—10 per cent. *Tulare*—50 per cent. *Yolo*—100 per cent. *Yuba*—60 per cent of last year's crop of 30 tons.

There is a very poor crop of shipping plums this year; much of the young fruit is still dropping.

Potatoes.

Inyo—75 per cent of last year's crop of 10,000 tons. *Kern*—15,000 sacks. *Los Angeles*—16,107,000 pounds. *Nevada*—170,000 pounds. *Orange*—25 per cent, due to decrease in acreage. *Sacramento*—75 per cent, due to dry weather. Late rains may help. *Siskiyou*—100 per cent. *Sonoma*—5,000,000 pounds. *Stanislaus*—10,000,000 pounds.

Present conditions indicate a much smaller crop than that of last year.

Prunes.

Alameda—In irrigated districts crop looks well, dropping elsewhere. *Butte*—90 per cent. *Contra Costa*—65 per cent. *Fresno*—20,000 pounds. *Glenn*—75 per cent. *Kern*—90 per cent. *Lake*—35 per cent. *Los Angeles*—15,000 pounds. *Madera*—100 per cent. *Mendocino*—25 per cent. *Monterey*—60 per cent. *Nevada*—50 per cent of last year's crop of 55,000 pounds. *Orange*—50 per cent better than last year's crop. *Riverside*—85 per cent of full crop. *Sacramento*—75 per cent. *San Benito*—50 per cent. *San Joaquin*—Good setting *Santa Clara*—Between 50,000,000 and 60,000,000 pounds. *Shasta*—Averaging 75 per cent. *Solano*—100 per cent. *Sonoma*—65 per cent of last year's dried crop of 16,500,000 pounds. *Stanislaus*—40 per cent of last year's crop of 8,000 pounds. *Sutter*—75 per cent. *Tehama*—50 per cent of last year's crop of 7,000,000 pounds. *Tulare*—30 per cent. *Yolo*—50 per cent.

The prune crop will be considerably less than that of last year as will be seen under statistics given in general crop conditions at the end.

Walnuts.

Glenn—Good bloom. *Lake*—50 per cent. *Los Angeles*—75 per cent of last year's crop of 6,112,000 pounds. *Nevada*—75 per cent of last year's crop of 13,800 pounds. *Orange*—125 per cent. *Riverside*—80 per cent. *Sacramento*—100 per cent. *San Bernardino*—90 per cent of full crop, orchards still young. *Santa Barbara*—3,146,850 pounds. *Siskiyou*—100 per cent, small acreage. *Sonoma*—100 per cent. *Stanislaus*—5,000 pounds. *Tulare*—65 per cent. *Ventura*—90 per cent of last year's crop of 1,900 tons; still too early for accurate statistics; setting apparently light.

Prospects indicate a good crop of walnuts throughout the State; however, less than that of last year.

GENERAL CROP CONDITIONS.

Prune Crop Situation.

The *Daily Commercial News*, May 20th, reports as follows: The present estimates of the crop at home and abroad in pounds are as follows:

	1912	1913
California	220,000,000	170,000,000
Oregon and Washington	10,000,000	30,000,000
Bosnia-Servia	Nothing	100,000,000
	230,000,000	300,000,000

The California Fruit Grower states that the crop will not exceed 100,000,000 pounds for California and will probably be less.

Cantaloupe Crop in Imperial Valley and Mexico.

There are many conflicting reports relative to the cantaloupe crop in the Imperial Valley and the following is taken from several. The total acreage in California is approximately 6,000 acres; in Mexico 800. It is believed that 3,000 refrigerator cars will be shipped out from California alone at a cash value of $2,335,000. This is the best year the industry has ever known.

The Pacific Northwest.

The Northwestern Fruit Exchange reports the following for May:

Apples.

The damage to apple crops in the Pacific Northwest is almost neglible. Some old trees that bore heavily will have a light crop this year, but the younger orchards will have more, so that the total apple crop promises to be as large as last year. Certain spots in the Yakima Valley lost from 25 per cent to 75 per cent by frost, but it was not general.

Pears.

A few pear orchards in the Rogue River Valley, Oregon, were touched with frost but not seriously.

The *Seattle Post-Intelligencer* gives the following comparative estimate in car loads for the fruit crops for the season of 1913:

	Wenatchee	Yakima
Apples	6,082	2,900
Apricots	137	------
Cherries	47	20
Grapes	-----	50
Peaches	432	1,600
Pears	279	250
Prunes and Plums	42	125

Florida Crop Conditions.

The following estimated conditions on May 1, 1913, with comparisons of the principal crops in Florida, on the basis of 100, representing a normal, is reported by the Crop Reporter of the U. S. Department of Agriculture, May, 1913, as follows:

Crop	May, 1913	May, 1912	May, 1911
Orange trees	90	96	80
Lemon trees	--	90	80
Lime trees	90	90	80
Grapefruit	88	98	60
Peaches	70	85	60
Pears	48	60	50
Strawberries	90	80	80
Watermelons	84	86	80
Cantaloupes	81	84	80
White potatoes	87	84	81
Cabbages	87	80	79
Cowpeas	83	83	85

INSECT NOTES.

Conducted by the editor.

The squash bug, *Anasa tristis* De Geer, is appearing in considerable numbers in the pumpkin fields near Sacramento this month.

The European grain or barley aphis, *Aphis avenæ* Fab., has been especially injurious to the spring crop of barley in Imperial County.

Horticultural Commissioner D. F. Norton of Nevada County, has sent in specimens of a beetle which is cutting off the tender shoots of young pear trees. This insect proves to be *Dascyllus plumbeus* Horn, a lead-colored beetle slightly over one half inch long. This is the first record we have of its being injurious.

A small scarabæid beetle, *Serica anthracina* Lec., has been doing damage to fruit trees in the Sierra foothills this spring. Prune, plum, and apple trees have been entirely defoliated in a few instances and the trees even killed. The beetle also works upon many of the native plants, chief of which is the manzanita. It has been collected in Nevada and El Dorado Counties by a member of the commission. A. R. Baird, Horticultural Commissioner of Inyo County, has also sent it to the office. It was reported as attacking the plum in Riverdale, Fresno County, in "Insect Life," Vol. V, No. 5, p. 350, July, 1893.

The fruit tree pulvinaria, *Pulvinaria amygdali* Ckll., has been found generally distributed in a prune orchard near Woodland, Cal., but not in sufficient numbers to be of economic concern. The leaves, petioles and occasionally the fruit afford lodging places for the egg-laying females. In the same orchard, the prune aphis, *Aphis prunifoliæ* Fitch, was very thick on a few of the tender shoots.

Small tenebrionid beetles are causing much worry among the farmers this year. Commissioner S. A. Pease of San Bernardino County has sent in two speices, *Ulus crassus* Lec., a small brown beetle one fourth of an inch long which was feeding on deciduous fruit trees at Ontario, Cal., and *Eurymetopon bicolor* Horn, a small black species about the same size which he found attacking deciduous fruit trees at Ontario, Cal., and apple trees at Yucaipe, Cal. A. S. Hoyt, deputy state quarantine officer, collected *Blapstinus discolor* Horn, a small black beetle about three sixteenths of an inch long, at Van Nuys, Cal., where it was feeding upon melon and tomato vines. Commissioner K. S. Knowlton has found it necessary to adopt control measures against three beetles, *Eleodes omissa* var. *borealis* Blaisd., *Eleodes armata* Lec., and *Asida lecontei* Horn, all of which are black and about three fourths of an inch long. They are attacking orange trees in Kern County.

The cypress twig-borer, *Phlœosinus punctatus* Lec., is a small brown scolytid beetle scarcely more than one eighth of an inch long, which bores into the cypress twigs usually in the axils of the branches. The twigs often break at these tunnels, thus resulting in severe pruning of hedges. Particular damage has been reported at Napa, Cal., this spring. It was reported from Oceanside, San Diego County, last year.

O. E. Bremner, deputy horticultural commissioner of Sonoma County, has sent in specimens of the yellow currant or gooseberry fruit fly, *Epochra canadensis* Loew. This insect is also quite common in other sections of middle California.

Specimens of the cherry fruit sawfly, *Hoplocampa cookei* Clarke, have been sent in by Mr. J. E. Hassler, county commissioner of El Dorado County, from Placerville, and by D. F. Norton, county commissioner of Nevada County, from Nevada City.

NOTES FROM THE COUNTY COMMISSIONERS.

El Dorado County.

Mr. J. E. Hassler has had remarkable success in controlling the blister mite on pear trees, especially on the fruit, with a lime spray composed of twelve pounds of quicklime to forty gallons of water.

Glenn County.

At a recent meeting of the Board of Supervisors, Mr. James Mills heartily endorsed the work of Carl J. Ley and asked that he be given proper office and field equipment.

Humboldt County.

Mr. Geo. B. Weatherby is planning a series of horticultural meetings in September and has engaged the services of the State Commissioner and Field Deputy to address the meetings.

Kern County.

Mr. K. S. Knowlton reports very serious damage to young orange trees in the county by the tenebrionid beetle, *Eleodes omissa* var. *borealis* Blaisd. He has inaugurated experiments against this insect by spraying with lead arsenate and Paris green.

Los Angeles County.

Mr. William Wood reports remarkable success in the control of the black peach aphis, *Aphis persicæ-niger,* with "Black Leaf 40" spray.

Modoc County.

Mr. O. C. McManus has lately been appointed county horticultural commissioner of Modoc County. He was the only candidate who passed the examination May 1st. He is very actively engaged in his new duties and finds plenty to do.

Riverside County.

Mr. R. P. Cundiff has just completed a very thorough inspection tour of his county.

San Diego County.

The supervisors have wisely provided their county horticultural commissioner with an automobile, which enables him to do an immense amount of practical field work and to keep in close touch with the problems of the growers.

Shasta County.

Mr. George Lamiman is conducting an active campaign against the oak rot fungus, *Armillaria mellea.*

Sonoma County.

Mr. A. R. Gallaway and Mr. O. E. Bremner have conducted a very thorough spraying campaign in their county this spring, which should result in a crop of clean fruit.

Sutter County.

Mr. H. P. Stabler is planning to make extensive exhibits of products raised in his county in a large building recently purchased by the supervisors. According to dispatches he has already established an office and display room in the building and other improvements are being made at his request.

Ventura County.

Upon the findings of Mr. H. S. Fawcett, plant pathologist of the State Commission of Horticulture, Mr. R. S. Vaile is advising his citrus growers to discontinue the use of neat's-foot oil for gummosis and to use Bordeaux paste instead.

Yolo County.

Mr. George H. Hecke has been a recent visitor to the State Commissioner's office. He reports conditions in his county as being very good considering the year.

Yuba County.

Mr. Geo. W. Harney reports that so far this spring he is unable to find any trace of the citrus white fly in Marysville.

QUARANTINE STATISTICS.

By Frederick Maskew, Chief Deputy Quarantine Officer, San Francisco, Cal.

With the passing of the month of April ended the first year in which the writer has had charge of the State Horticultural Quarantine service with headquarters at the port of San Francisco. Several changes have been instituted in the methods of conducting the service during that period, and the inspection force has also been increased. For the direction of future policies it was considered necessary to obtain a tabulated form of the results of the work under these new methods. With that end in view a comparative analysis of the statistics covering a period of two consecutive years' work of the force employed has been compiled by Miss E. Clare Dutton, clerk of the division. The findings are such as to make this department feel justified in publishing them, and the same are herewith presented:

Importations of Horticultural Products.

From May 1, 1911, to April 30, 1912.		*From May 1, 1912, to April 30, 1913.*	
Ships inspected	348	Ships inspected	419
Total parcels intercepted	654,107	Total parcels intercepted	701,986
Parcels in baggage of passengers and crew	1,828	Parcels in baggage of passengers and crew	3,399
Express shipments	------	Express shipments	1,971
San Mateo County shipments	15	San Mateo County shipments	167

In an attempt to digest the comparative value of the foregoing it is my opinion that 419 against 348, an increase of 71 ships inspected in a similar period of time, is largely if not entirely a matter of natural fluctuation in trade conditions, and the same may be considered in the case of 701,986 against 654,107, a gain of 47,879 parcels of horticultural products in our favor.

The items worthy of careful consideration, and which are by far the most important in my opinion, are the ones concerned with the parcels of horticultural products intercepted in the baggage of the passengers and crews. This is where the contraband material is usually found, and it was for the purpose of strengthening this branch of the service that I asked for and was granted two additional inspectors. In view of all the publicity that has been given to this matter during this period, as well as the co-operation of the Federal Government, 3,399 against 1,828, a gain of 2,571 parcels in one year from this source is an object lesson which I consider supports my previous judgment of the necessity of augmenting the inspection force.

One of the first things I set in motion after taking charge of this work was a systematic study of all the avenues of entrance into the port of San Francisco that were open to horticultural products, for the purpose of locating leaks in the quarantine service. The items set down in the table as express shipments are proof that such leaks existed. In editing the daily reports of the inspectors I soon noticed the absence of shipments by express, and a search of the books showed that none such had been inspected or recorded for a year previous. It required both persistent and positive efforts to permanently stop this leak, but it is now one of the most perfectly working phases of the quarantine work, and has yielded up from the express office in the Ferry Building 1,971 parcels of horticultural products that come under our jurisdiction in a space of ten months. Out of this mass of material we intercepted and destroyed 44 lots of fruit fly material, 1 lot of white fly material, and 1 lot of contraband peach trees.

As a result of the enforcement of the provisions of section 1 of the state quarantine law in the matter of arrival of interstate shipments, it became incumbent upon us to attend to this same class of material arriving at points in San Mateo County. This has monopolized a great deal of valuable time, but we have kept up the work and it has yielded good returns.

Enforcing the Federal quarantines on material from European points has brought some interesting developments in our dealings with the parcel post, and the performance of work that should be the duty of a county horticultural commissioner has kept us busy. To all of those who are sufficiently interested in this work to read the foregoing it must be apparent that the quarantine service has not remained stationary. In the opinion of the writer, who believes that the service is still far from being perfect, the progress for the year has been satisfactory.

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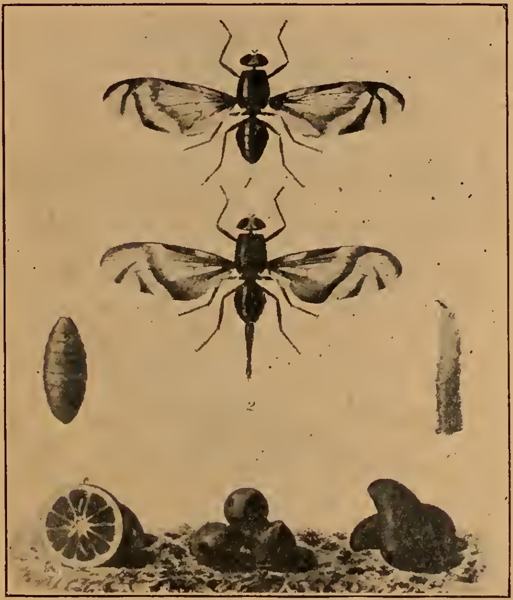

Various stages of the Mexican orange maggot and some of the host fruits. (From Com. de Parasitologia Agricola, Mexico. Photo by Chatterley.)

OF

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STATE COMMISSION OF HORTICULTURE

July, 1913

THE MONTHLY BULLETIN

VOLUME II No. 7

DEVOTED TO THE DESCRIPTIONS, LIFE HABITS AND METHODS OF CONTROL OF INSECTS, FUNGOID DISEASES AND NOXIOUS WEEDS AND ANIMALS, ESPECIALLY IN THEIR RELATIONS TO AGRICULTURE AND HORTICULTURE.

EDITED BY THE ENTIRE FORCE OF THE COMMISSION UNDER THE FOLLOWING DIRECTORS:

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1913

THE HORTICULTURAL PICKET LINE.

By **Frederick Maskew**, Chief Deputy State Quarantine Officer and Federal Quarantine Officer, San Francisco, Cal.

When Alexander Craw in November, 1899, at the Port of San Francisco detected the maggots in a shipment of oranges from Acapulco, he established the first outpost of a picket line that now encircles the entire United States. The passing by Congress of the Plant Quarantine Act on August 20, 1912, created the Federal Horticultural Board, and one of the first acts of that body—after a thorough investigation of the men and their methods of inspection—was to enlist the services of the State quarantine officers of California as collaborators of the United States Department of Agriculture. Notice of Quarantine No. 5 (foreign) The Mexican fruit fly, was declared on January 15, 1913, and the embargo maintained for twelve years at every port of entry on the coast line of California was at once extended to every port of entry in the United States. Working in conjunction with the Federal Horticultural Board and the State Commissioner of Horticulture, the writer of this article investigated in person the methods employed by the United States Customs officers in putting into execution the provisions of Quarantine No. 5 at every port of entry along the international boundary line from Yuma, Arizona, to Brownsville, Texas.

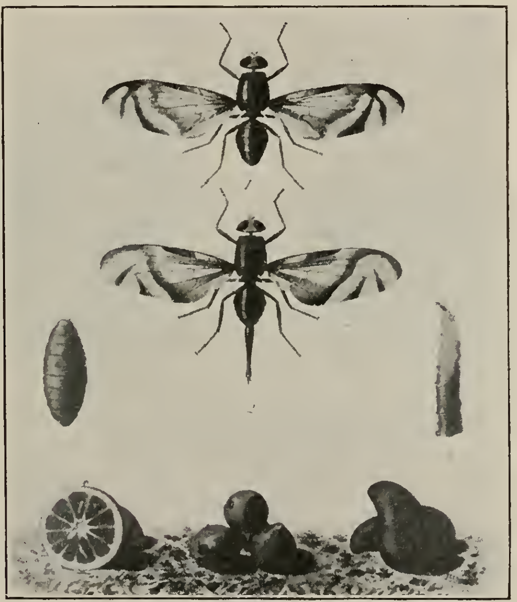

Fig. 334. Various stages of the Mexican orange maggot and some of the common host fruits including oranges, guavas and mangoes. (From Commission de Parasitologia Agricola, Mexico. Photo by Chatterley.)

At Nogales where the Southern Pacific of Mexico enters the United States, I watched the interception of pedestrians crossing the line, and assisted in searching the baggage of passengers who came in by rail. The quarantine on fruit is maintained and its real purpose clearly comprehended by those in authority at this point. At Naco, Collector Randall's duties in this matter are light, the movement of fruit being in the opposite direction, from the United States into the great mining town of Cananea located forty miles away. Records show the only imports of fruit to be Sonora oranges via Lomas and Del Rio en route in bond for foreign points. No local traffic from this point can reach fruit growing or fruit fly districts in Mexico. At Douglas a pernicious practice formerly prevailed. Mexican oranges in carload lots were routed through in bond to Agua Prieta and eventually brought back across the line in small quantities to be distributed in Douglas and adjoining towns in Arizona. Collector Fitzherbert has effectually stopped all such procedures as this, and no Mexican fruit can now pass into the United States at this point. The railroad crossing the international line at Douglas reaches only to Naco Zari, about ninety miles south. No fruit of any kind is grown in the territory tributary to this road. There is no railroad crossing at Columbus in New Mexico; a cattle trail stretches its interminable length into the desert on either side of the national boundary. Here the simple question of distance is a protection that automatically protects, and precludes the possibility of bringing in fruit by any of the methods of transportation available on this route. Nevertheless, the Customs inspector stationed at this port has his orders to confiscate and destroy all fruit that he may encounter.

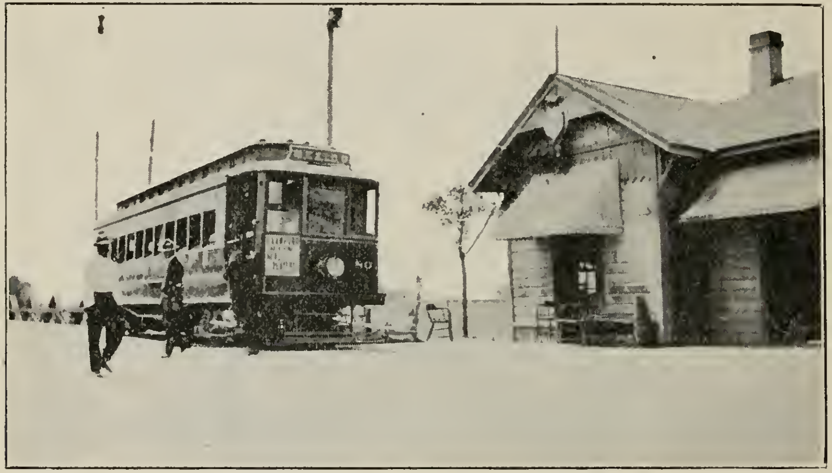

FIG. 335. Street car from Mexico at El Paso, Texas, stopped and searched at the international line by federal officers. (Original.)

El Paso is the crux of this quarantine situation on the border. Here arrive trains over the Mexican national lines from all the fruit fly districts in Mexico. Under normal conditions the tourist traffic is large in volume and constitutes the real danger. Curiosity is inherent in each of us, and the all too common antagonism to any attempt to regulate personal tastes by enacted laws applies equally to contraband fruit as otherwise. "Uncle" Joe Dwyer, the veteran inspector, courteous, alert, implacable, is master of this traffic situation. By the courtesy of Collector Sharp I was enabled to observe and study all the methods employed in maintaining a quarantine against the Mexican fruit fly at this important port of entry. Using the drastic measures in vogue at San Francisco as a standard of comparison, I came away convinced and satisfied. All passenger trains are stopped, held and boarded at the international line by United States Customs and Immigration officers. All passengers are registered, their belongings searched, and all fruit as well as all other articles of contraband confiscated. The train in charge of the United States officials then proceeds to the Union depot where all trunks and packages are taken into the inspection room, opened and searched.

Going into Mexico via Stanton street, traversing the principal thoroughfares of Juarez and returning into El Paso, street cars run on a fifteen minute schedule. I made the round trip over this route several times before presenting my credentials to the United States Customs officials. In each instance when the returning car reached the United States boundary line it was stopped and boarded by a Customs inspector, an immigration officer and a soldier. In common with all other passengers I was interrogated concerning my purchases made in Mexico, compelled to open and submit their contents to inspection, and requested to stand up for a closer scrutiny. Later I associated myself with the inspectors stationed on these bridges, witnessed their examination, not alone of the car passengers but of every person coming out of Mexico. No contraband fruit is crossing the dead line here.

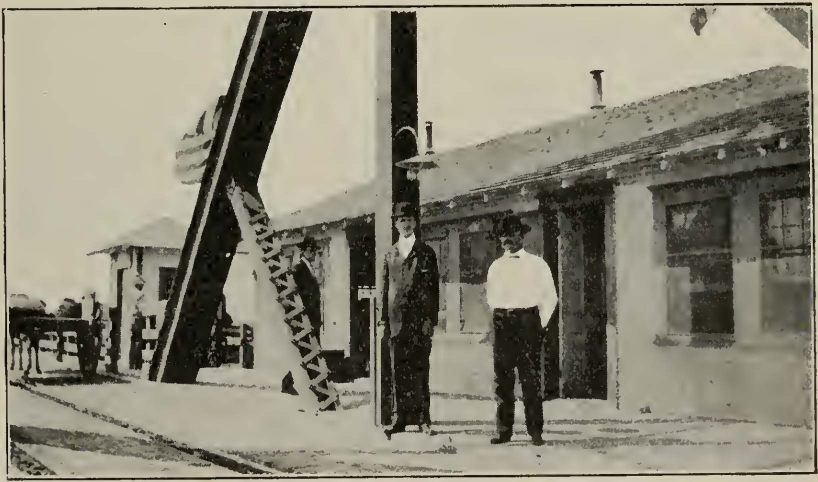

FIG. 336. The international bridge at Brownsville, Texas. Federal officers waiting to inspect passengers and their baggage on a train arriving from Mexican points. (Original.)

Eagle Pass in times of peace is also an important railroad crossing. The difference of opinion at present prevailing along the border as to which faction shall collect the Customs duties has caused traffic by rail from all Mexican points to cease. Here, as at all other points of entry, orders to all concerned are to confiscate all host fruits of *Trypeta ludens* found attempting to cross the line. I found a copy of these orders together with a list of the fruits quarantined, tacked on the wall of the Customs office located midway on the international bridge. A day spent at this point observing what happens to all of those who are returning with their purchases of carne, verdugas and fruita made in the Municipal market at Porfirio Diaz would satisfy the most captious that this avenue of entrance is closed to the fruit flies.

Laredo is connected by rail with all points in the Republic. Through this port of entry came into the United States the bulk of the commercial shipments of oranges from Mexico prior to the issuance of Notice of Quarantine No. 5. The best criterion that a student can use to judge of the effect of this order in stopping all imports of quarantined fruits from crossing the line or being locally distributed in this vicinity, is the bitter comments of many of those who live or do business in the city of Laredo. The importance also of confiscating the individual specimens of fruit found in the possession of both through and local travelers is fully realized and put into effect by those whose official duty it is to search for contraband articles both on the trains and on the bridge.

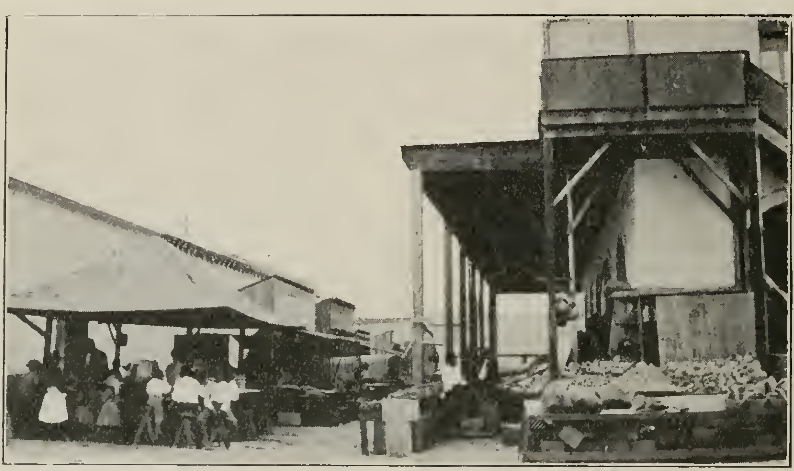

FIG. 337. Fruit in the municipal market at Neuva Laredo, Mexico. (Original.)

At Brownsville an opportunity of demonstrating the positive necessity of this quarantine order presented itself. During my visit a passenger train arrived from the city of Mexico, the first to come through in six weeks. On the international bridge in company with the Immigration officers, the Customs inspectors and Dr. Fairchild of the Public Health service, I boarded this train and took a part in searching the baggage. Among other things we found about twenty-five oranges. Five of these were found in the hand bag of a through passenger in the pullman coach; fine, smooth, thin-skinned fruit, without any external blemish, and encased in wrappers bearing the following legend printed in colors: "Hacienda Vista Hermosa, El Cercado Nuevo Leon." In the Customs baggage room at the depot in Brownsville I opened these oranges, found the maggotts of the Mexican fruit fly, and before destroying them exhibited the same to the officials whose duty it is to confiscate all such fruit. This was an object lesson of value, the effect of which will be lasting, and the story of this same finding will eventually pass from station to station along the entire length of the border.

There are many minor ports of entry along the border other than those which I have enumerated. At all of these I found in force the same imperative orders to prevent the passing of quarantined fruits. The very nature of the country through which these routes pass is in itself the best possible protection, and in the matter of danger from infested fruit found in the Municipal markets of the Mexican border towns, (most of which I visited), the absence of any growing host fruits, in fact, any evidence or possibility of cultivation for many miles contiguous to either side of the line from Yuma to Brownsville precludes the possibility of such fruit flies as emerge from the fruit in these markets finding a local host upon which to perpetuate themselves. The railroad crossings and the through passengers are the true source of possible contamination of our orchards, and all fruit passing through these is now controlled by the United States Customs inspectors.

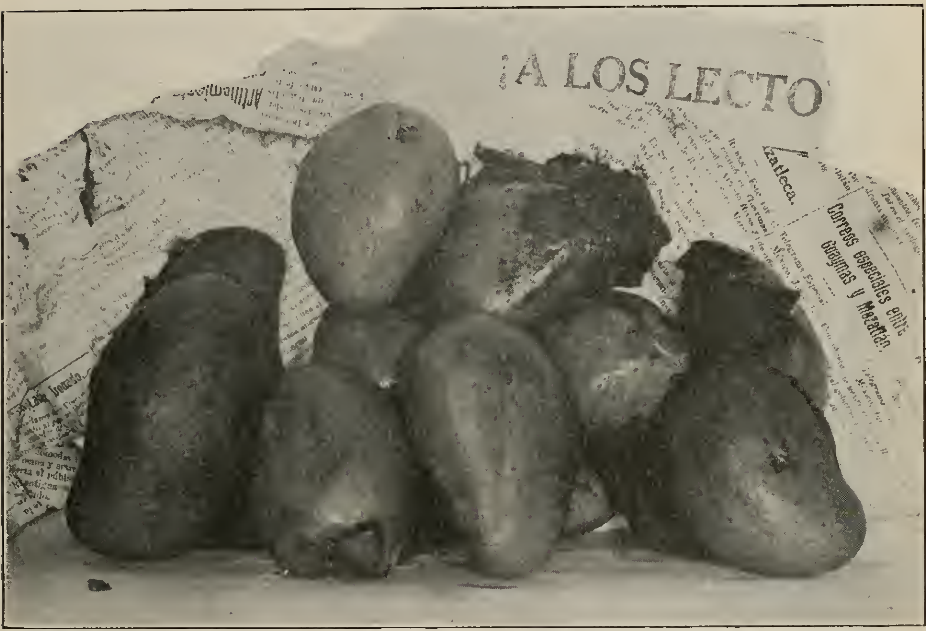

FIG. 338. Mexican mangoes taken in the parcels post. (Photo by L. A. Whitney.)

At the coast ports of entry in California there has always been co-operation between the two services. This grew up as a result of daily association and mutual appreciation of each other's endeavors and interests in their individual duties. and was entirely voluntary. With the advent of the United States Department of Agriculture into this horticultural quarantine work the co-operation of the United States Treasury Department was promptly obtained and official orders in the nature of Treasury Decisions were sent out broadcast. A "T.D." in the Customs service is the same as a general order to an army; it is imperative, absolute, final; admits of no deviation, and meets with none; means just what it says; applies to every individual in the service, and is carried out to the letter. If a "T.D." prohibits any article from passing a stated point, that is all there is to it; the article in question does not pass. As an illustration of this statement, I have stopped writing this article at this point long enough to inspect a shipment of Mexican mangoes that were turned over to one of my inspectors on this 25th day of June, 1913, by the Customs inspector at the San Francisco post office; a package by registered parcel post from Mexico addressed to Luisa de Antonio, 12 Scott street, San Francisco, in which were found, confiscated and destroyed thirteen mangoes.

For the permanent peace of mind of the fruit growers of California in so far as the Mexican fruit fly is concerned, I herewith reproduce a Treasury Decision that I found in evidence at every port of entry on the boundary line between Mexico and the United States, and what is more to the point, I found the provisions set forth in the same being put into effect:

TREASURY DEPARTMENT, UNITED STATES CUSTOMS SERVICE,
OFFICE OF THE COLLECTOR.

To Customs Inspectors:

"Referred to Notice of Quarantine No. 5, (Foreign), under the Plant Quarantine Act of August 20, 1912, (T.D. 33110), prohibiting the importation from Mexico of certain fruit, the Secretary of Agriculture requests that your attention be called strongly to the desirability of excluding all fruit covered in this Notice of Quarantine.

The Secretary adds that the danger from a small quantity of fruit which may be carried by travelers in their hand baggage is as great, if not greater, than that which might be offered for commercial entry, and that such travelers if en route for California, for example, might easily carry Mexican oranges with them into the citrus districts, and finding them wormy throw them out of the car windows or otherwise dispose of them, thus introducing the Mexican orange maggot into the very heart of our most important citrus district. The Secretary desires, therefore, that you be made fully cognizant of this danger.

For the reasons above set forth, you are enjoined to observe the greatest care to exclude all the fruit in question."

The fruits referred to are Oranges, Sweet Limes, Mangoes, Achras, Sapotes, Grapefruit, Peaches, Guavas, and Plums. (T.D. 33071, 33110, 33247.)"

Try and realize what this means. The rank and file of that great army the United States Customs service, awakened to a true sense of the fact that there are other things more permanently injurious, more deadly and fatal to California's future than opium; that in the final analysis a maggoty mango is more to be dreaded as an ultimate treasury depleter than all the diamond smugglers that ever crossed the border; that the finding and confiscation of fruit fly material is one of the paramount purposes of searching personal baggage and ships' interiors; that a string bean has now as much significance as a string of pearls, and you will begin to obtain a true perspective of the system of protection that has developed mainly as a result of the practical persistent work, the examples and the precepts set and maintained by the horticultural quarantine officers of the State of California.

THE KIND OF FRUIT THAT PAYS.

By Geo. P. Weldon, Chief Deputy Commissioner of Horticulture, Sacramento, Cal.

California is noted for its splendid fruits, and the climate of the State is such that a great diversity of them may be grown. Certain sections are found to be best adapted to the growing of certain fruits, and the prospective orchardist can find practically anything to his liking somewhere within the State.

The kind of fruit that one should grow will depend largely upon what has been tested in the particular locality where he settles and which has proven a success.

It matters not whether peaches, apricots, apples, pears, prunes, oranges, lemons, or cherries are grown, the one rule holds true, that only good fruit will command the best prices. The variety of a particular kind of fruit, whether citrus or deciduous, may mean much but size and quality usually mean much more. Small, scabby, ill-shapen fruit is not desirable, and the man who neglects his orchard to the extent that his fruit will be of low grade must surely take the consequences in the way of poor prices, and often failure, where success should be his.

The statement has often been made that there are more fruit growers than orchardists. California may well boast of her orchardists. As a class I am told they are men who could succeed in almost any other line of business. Many of them are college or university graduates. Up-to-date scientific methods appeal to them, and no efforts are spared to check disease when it appears; to fight insect pests that threaten their crops; to prune intelligently; to fertilize properly; in fact, to do everything that tends to improve the size, appearance, and quality of their fruit.

There are three things that are of great importance in practically every orchard, viz, fertilization, pruning and thinning. Besides these there are often insect pests or fungous diseases that require attention. Spraying may have to be done to control certain of these, and the man who studies his orchard so that he knows how and when to fertilize, when to prune, when to thin and when to spray for insect pests or diseases, is the man who is going to make the greatest success.

It is true that there are many troubles of the orchard that are not well enough understoood so that they may be controlled, and it is necessary to be constantly alert, ready to experiment with things that promise to give aid, and to co-operate with those who are giving their time to the solution of such problems.

None of the specific problems that we have will be discussed in this article, but from time to time it is hoped that some of these may be taken up in articles for the Bulletin. There are many conditions of soil, climate and locality that must be considered in making recommendations for the care of an orchard. The field worker should bring himself into close touch with all these problems throughout the State that so vitally effect the grade and quality of our fruit.

Many illustrations might be given of good fruit selling for a good price and bringing a nice profit to the grower, while poor fruit on the same market brought nothing. Cases of this kind are familiar to practically every man who reads the Bulletin and it is not necessary to mention any specific ones.

Too often the fruit grower has been misled to think that success will come easy to any one who owns an orchard. This idea should be discouraged in every way possible. Success will come to the grower who is not afraid to roll up his sleeves and work; who is willing to listen to the advice of neighbors who have succeeded; who is willing to read and determine the best methods in vogue for the various operations of his business. Any man can grow fruit trees and poor fruit, but it takes an orchardist to grow the best trees and the best fruit.

ORCHIDS AND THEIR SCALE PESTS AS FOUND AT THE PORT OF SAN FRANCISCO.

By B. B. WHITNEY, State Quarantine Inspector, San Francisco, Cal.

The orchids form a vast group of plants, (about 10,000 species). Immense sums are paid for new plants. The price paid for novelties causes collectors to scour every part of the tropics, risking their lives in the mountains, jungles and fever-haunted swamps in search of these plants. It is probable that large sums for single plants have been paid more frequently for orchids than for any other class of plants. Large quantities of orchids are annually imported to replenish hothouses. There never has been any distinct orchid craze followed by a severe reaction, as in the case of the tulip, dahlia, zinnia, camellia, etc., but the interest has gradually extended, and is likely always to increase steadily.

Orchids may be divided into three classes: saprophytes, epiphytes and terrestrial orchids. True parasites are not known to occur in this family.

The saprophytic orchids are the most reduced forms devoid of chlorophyll, and depending for their carbon food upon the organic matter of the humus in which they grow. The subterranean stem or rhizome consists of a much knotted coral-like mass, which takes the place of roots. In most species the rhizome has been found to be infested with a fungus, by means of which organic matter of the humus is absorbed and transformed into compounds available to the plant.

The epiphytic orchids exhibit the most varied forms. These inhabit branches of trees, dead trunks, and often barren rocks, in tropical or subtropical countries where a part of the year is unfavorable to growth. As a result of this they have developed special food reservoirs, pseudobulbs, terminating each season's growth. In this group there are comparatively few plants of attractive habit.

The terrestrial species include some of the largest and most stately orchids of the tropics as well as most of the orchids of the temperate zone. Many of these are ornamental even when not in flower.

Fruit growers, as a rule, are not much concerned about orchids, neither, as a rule, is the quarantine officer, but the latter is vitally concerned about the insect pests that he finds invariably associated with the consignments of these valuable plants that he very often is called upon to examine. The following list of scale insects that the writer has detected and caused to be destroyed upon orchids entering the port of San Francisco, contains the names of a great number that are well known tree pests in different parts of the world:

The following list contains all the species listed by Cockerell as attacking orchids, excepting seven. It also contains ten species not listed by the same author:

Scale pest.	Habitat.
Conchaspis sps.	Mexico
Asterolecanium epidendri	South America
Ceroputo and *Pulvinaria* sps.	South America
Vinsonia stellifera	Mexico
Eucalymanatus perforatus	England
Coccus acuminatus	Hawaiian Islands
Saissetia hemisphærica	Mexico
Diaspis boisduvalii	South America and England
Diaspis cattleyæ	England
Diaspis echinocacti	South America
Hemichionaspis aspidistræ	England
Hemichionaspis sps.	Manila
Fiorinia sps.	Manila
Aspidiotus cyanophylli	Mexico
Aspidiotus hederæ	Conservatory, Golden Gate Park, San Francisco
Chrysomphalus alienus	London
Chrysomphalus aonidum	Conservatory, Golden Gate Park, San Francisco
Chrysomphalus biformis	South America
Chrysomphalus biformis cattleyæ	Jamaica
Chrysomphalus dictyospermi var. *arecæ*	Golden Gate Park, San Francisco
Lepidosaphes cocculi	Manila
Lepidosaphes pallida	Java
Lepidosaphes sps.	South America
Parlatoria mangiferæ	Singapore
Parlatoria pergandii	Conservatory, Golden Gate Park, San Francisco
Parlatoria proteus	Orient
Parlatoria sps.	Manila
Parlatoria pseudaspidiotus	Recorded in India

The following seven species listed by Cockerell have not been taken so far at the port of San Francisco:

Conchaspis angræci.
Asterolecanium aureum.
Pulvinaria (brassiæ) floccifera.
Ctenochiton elongatus.
Coccus hesperidum.
Fiorinia stricta.
Lepidosaphes pinnæformis.

The working out and identifying of the foregoing material was a task of some magnitude, considering that all of it had to be done during the rare intervals that have occurred in the regular routine work of the quarantine service; but the series of splendid specimens that this work has added to the State collection amply justified the effort.

THE SEED LAW AND THE STATE SEED GROWERS' ASSOCIATION IN WASHINGTON.

By LOUISE M. ALLEN, State Seed Analyst, Seattle, Washington.

In 1909 the legislature of Washington enacted a law relating to the sale of and fixing the standard of purity of agricultural seeds. The enforcement of the law was put in the hands of the State Dairy and Food Commissioner. At this time no appropriation was made for carrying on the work, but the legislature of 1911 appropriated funds. The work of establishing a laboratory was at once begun and a seed analyst was appointed.

Briefly, the law is as follows:

All seed dealers are required to label their seeds, giving a statement of their purity and specifying the kind and percentage of the impurities, provided said seeds are below the standards fixed by the act. If they are above the standards, the label may bear the word "Standard."

The sale of seeds containing dodder, quack grass, Canada thistle, corn cockle, wild oats and charlock, is prohibited.

Provision is made for any person who is going to use the seed himself, to have it tested, free of charge, at the State Seed Testing Laboratory.

The department has made the work educational, as far as possible. Farmers' meetings have been held, seed dealers visited and exhibits made at State and county fairs in various parts of the State. In this way the people are told of the idea of the seed law, the advantage of having their seed tested and a card with the address of the laboratory distributed, so that they may send in samples. About four hundred samples were tested last year.

In addition to the educational work the stock of dealers over the State is sampled and tested to show whether their labels are correct. The dealers have complied with the law and poor grades of seed are rapidly disappearing.

Dodder is the commonest of the "noxious" weed seeds, as it occurs in our two most important forage crops, *i.e.*, red clover and alfalfa. Wherever it is found the lot of seed is condemned and the dealer ordered not to sell it in the State. Several carload lots and many lots of a few tons or bags have been condemned and shipped out of the State. One carload of alfalfa, containing approximately one hundred dodder seeds per pound was shipped to Lawrence, Kansas. Another containing some of the same alfalfa and red clover with approximately six hundred dodder seeds per pound was shipped to Milwaukee. A third of alfalfa went to Oregon.

As a result of this movement for better seeds throughout the State, a number of men, interested in the growing of seeds, met at the close of the State Grange meeting in June and formed a temporary organization of the State Seed Growers' Association. Temporary officers, including an executive committee to draft a constitution and by-laws, were elected. The aims of this organization are:

To interest growers in the production of high grade clean seed.

In the production and sale of varieties of seed, true to name, *i.e.*, applied especially to spring and winter wheat and the different varieties of both of these.

To provide a ready market for such carefully produced seed to which the name "pedigreed seed" is well applied.

For a grower to be able to say that there was neither dodder nor any other weeds growing in the field where his red clover seed was produced should put it far ahead of any of the ordinary sort of seed offered for sale. A large per cent of the red clover seed sold in this country is imported from Europe, where dodder and many other bad weeds are abundant. Our commonest weed pests have, many of them, been brought to us in this way.

The permanent organization of the Seed Growers' Association will undoubtedly be completed in a few months.

With the constantly increasing demand for better grades of seeds, on the part of both farmers and dealers in the State, and the remarkably favorable conditions for seed production here, growing for the market should be a very good industry. It is true that within the last year a vast improvement in the quality of the seed offered for sale in the State is noticeable. With the combined efforts of the Commissioner in charge and Seed Growers' Association, Washington farmers should be able to buy high grade clean seed.

A NEW HOST PLANT OF THE CALIFORNIA GRAPE ROOT-WORM.

(Adoxus obscurus Linn.)

By EDW. J. BRANIGAN, Field Deputy, State Insectary, Sacramento, Cal.

While on a recent trip into the high Sierras engaged in the regular fall field work of locating the winter hibernating quarters of *Hippodamia convergens* Guer., the native ladybird beetle, which is used so extensively by California growers in combating the attacks of various species of aphids, my attention was attracted by the very peculiar insect injury to the leaves and roots of a very large plant (*Saxifraga peltata* Torr.[1]) which grows so abundantly along the borders of swift running streams that in many cases it entirely covers the rocks. The roots extend into the shallow water and the plant sends forth dense foliage in such profusion as to hide the water for some distance. The leaves are very large.

Upon examination of this plant I found the leaves to appear like fine net work, due to the severe attacks of some leaf-eating insect, and upon closer inspection noted that this injury bore a marked resemblance to the injury inflicted upon the foliage of the grape when attacked by the California grape root-worm (*Adoxus obscurus*). The roots also showed a similar injury.

Knowing this insect to occur practically all through the Sierra Nevada Mountains at a great variety of elevations, ranging from the valley as high as the snow field of Mount Rainier, along the Sierras at an elevation of 10,000 feet, at which altitude a few specimens had been taken, a minute inspection of the work upon *Saxifraga peltata* was made, which showed conclusively that it was done by *Adoxus obscurus,* which at times does considerable damage to vineyards throughout the State.

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[1] Jepson in his book—"Flora of Western Middle California"—has the following to say of *Saxifraga peltata* Torr.: "It is a remarkable species of the Sierra Nevada and Yollo Bolly mountains, growing along swiftly flowing mountain streams; it has peltate leaves one to two feet in diameter and petioles two to three and one half feet high."

A careful search of the infested area gave no sign of adults, which was probably due to the lateness of the season. The damage to the foliage was complete, the spaces between the veins of the leaf having the appearance of lace work and the narrow slits, so characteristic of this species on grape, were as thick as they could possibly be, all of which strengthened the belief that *Adoxus obscurus* had adapted itself to a new host plant. Diligent search in this and adjoining areas finally revealed a few adults, which I at once collected together with specimens of leaves showing damage and brought the same to the Insectary, where they were identified as *Adoxus obscurus.* Later, our identification was verified by Charles Fuchs, of the California Academy of Sciences.

The specimens were collected in Canyon Creek, which is a tributary of the north fork of the American River, Placer County, at an elevation of 3,700 feet, during the latter part of October, 1912.

DR. SYLVESTRI'S WEST AFRICAN MISSION.

By HARRY S. SMITH, Superintendent State Insectary, Sacramento, Cal.

Anything that affects the status of the fruit fly in Hawaii is of vital importance to the fruit growers of California. They will then be interested to know something of the results of Dr. Silvestri's recent trip to the west coast of Africa for the purpose of obtaining, if possible, parasites to use against this pest.

On his way to Italy Dr. Silvestri spent a day at the State Insectary a couple of weeks ago. He reports a most interesting and apparently successful year's work. Leaving his home near Naples the first of July a year ago he proceeded directly to the west coast of Africa. About six months were spent in the search for the fruit fly and its parasites in that region, the remainder of the time being occupied in traveling from place to place, transportation being very poor in that part of the world.

Although a great many species of the fruit fly family were encountered, the Mediterranean fruit fly, *Ceratitis capitata,* was very scarce. However, the habits of these other flies are so similar to that of the particular one which was the object of his search, that it is hoped and believed the parasites attacking these will also attack *C. capitata.* Considerable time was spent in Nigeria and Dr. Silvestri makes the statement that here is the place of all places where the search should be carried on.

Large numbers of various species of fruit flies were collected and parasites reared out and brought to the Hawaiian Islands alive. The greatest difficulty was experienced in keeping the material in a living state, due to the fact that four months were required to make the journey from West Africa to Honolulu. Dr. Silvestri found that the method so successfully used in the gypsy moth parasite laboratory, that of keeping the adult parasites in glass tubes, feeding them with droplets of honey or sweetened water with a leaf enclosed for the purpose of supplying the proper amount of moisture, was most successful for his purposes. Cold-storage was found to be of practically no value in this particular instance.

Several hymenopterous parasites of the groups *Braconidæ*, *Proctotrypoidea* and *Chalcidoidea* were found and brought to the Islands in a living condition.

The Hawaiian entomologists have been leaders in this sort of work and have carried it on with much vigor, and with Dr. Silvestri to do the collecting, it would seem as though the project should be made a success if the thing can be done. One of the great difficulties with which it is necessary to contend is the fact that the parasites so far discovered, with one exception, are unable to reach the maggots when they occur deep beneath the skin of large fruit such as oranges. The exception mentioned above, is a parasite found by Dr. Silvestri on this trip, which oviposits within the egg of the fruit fly. The maggot hatches from the egg and bores into the fruit, but no matter how deeply beneath the surface it goes it still bears within its body the larvæ of the parasite and will be destroyed before it becomes mature. This parasite would seem to be the most promising of all, and it is to be hoped can successfully be introduced into the islands and that it will thrive in that climate. The growers of this State should follow closely the work of the Hawaiian entomologists, as any reduction in the abundance of fruit flies in the islands means a reduction in our chances of getting it in California. The Mediterranean fruit fly seems to be one of the few insects for the control of which there is little hope in artificial methods, and for this reason Hawaii is abundantly justified in sparing no efforts to secure and establish natural enemies of this pest.

The complete report of Dr. Silvestri on this mission will be published by the Hawaiian Government during the coming year, and should be obtained by all who are interested.

THE BRANCH AND TWIG BORER.

(*Polycaon confertus* Lec.)

Order—Coleoptera. Family—Bostrychidæ.

By E. O. Essig, Secretary State Commission of Horticulture, Sacramento, Cal.

Summary.

1. Considerable damage is often done to young trees by the branch and twig borer (*Polycaon confertus* Lec.).

2. This beetle is not likely to continue destructive enough in any one locality for a period of years to warrant the expense of control.

3. The presence of the beetle is characterized by smooth, round burrows which are usually located in the axils of the buds or small branches or by the broken twigs caused by these burrows.

4. The insects are slender, brown beetles, averaging from three to five eights of an inch long.

5. Control measures consist in cutting out and burning infested twigs and in destroying the beetles in their shallow burrows with a wire.

6. The branch and twig borer is generally distributed throughout the State.

7. The live oak appears to be the native food plant but grapes and nearly all the pome fruit trees are attacked.

Damage.

Within the last two months there have been repeated calls to this office for information regarding an insect which was apparently doing considerable damage to young fruit trees in various sections of the State. The seriousness of the attacks this year led many to believe that a new fruit pest had appeared. In not a few cases young orchards have been seriously injured by the excessive pruning caused by the twigs breaking off at the burrows made by the insect. Large branches are not seriously injured except that the tunnels afford excellent hibernating quarters for other insect pests and ready breeding places for parasitic fungi. The damage to the small twigs is due to the large burrows which so weaken them that they can not sustain their own weight and thus break. Small olive trees have apparently suffered most.

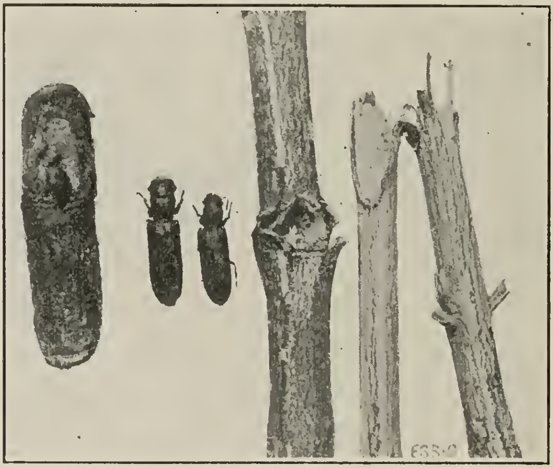

FIG. 339. The branch and twig borer, *Polycaon confertus* Lec. Beginning at the left: beetle at work in burrow; adult female and male beetles; twig showing entrance of burrow; twig broken at the burrow. All natural size. (Original.)

In spite of the above record it does not appear that the insect has ever been a really serious pest except occasionally. Records dating as far back as 1883 show the same conditions to have existed then.

H. F. Wilson and A. L. Lovett[1] report the following conditions in Oregon: "Although apparently never doing any amount of damage, this insect is often found attacking the stems and branches of pome fruits and even grapes. * * * They have never been abundant enough to cause any great alarm, but the burrows offer excellent opportunity for the entrance of fungi and decay organisms."

It is not likely that the insect will become a more serious pest in the future.

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[1] Biennial Crop Pest and Horticultural Report, 1911-1912, p. 161.

Work.

The work of the beetle is very characteristic consisting of clean round burrows in the branches extending into the pith or even through to the other side. These burrows are usually from one eighth to one fourth of an inch in diameter and scarcely more than one inch in length. In making these the beetles begin in the axil of a bud or small branch and bore downward. It is not at all difficult to find them doing this.

Appearance and Life History.

The adult beetles are shown in Fig. 339. They vary considerably in size and are usually from three to five eighths of an inch long. They are narrow, the head as wide or slightly wider than the prothorax. The color varies from light to very dark brown and the entire body is covered with short, fine hairs, which are noticeably thick on the head and prothorax. The movements are very slow and deliberate.

The life history of the beetle is very imperfectly known. In 1881, Matthew Cooke[2] recorded it as a pest in California. He supposed that the eggs were deposited in forest trees within which the larvæ subsequently lived. This belief was practically substantiated by the work of Dr. F. E. Blaisdell,[3] who reared adults from larvæ in live oak and almond trees. The writer has been unable to find other records of the young attacking orchard trees.

In all the instances noticed the adults are doing the damage. They work in the spring and early summer, disappearing as suddenly as they came.

Control.

At the present there is no known means of preventing the attacks of this borer. The only remedies suggested are to cut and burn the infested twigs and to destroy the beetles in the burrows by means of a short wire or knife blade. Both of these are tedious and require constant vigilance to be effective.

Distribution.

Matthew Cooke records this insect from Solano and Sonoma counties. Dr. Blaisdell collected it in Calaveras County. The writer has received it from, or collected it in, the following counties: El Dorado, Napa, Riverside, Sacramento, Tehama, Ventura and Yolo. To these Prof. Woodworth adds Mendocino, Santa Cruz, Santa Clara, Contra Costa, Alameda, San Joaquin and Butte.

From the above it will be seen that it is generally distributed throughout the State.

Food Plants.

The list of plants attacked by the branch and twig borer is already large and is likely to increase with the amount of orchard inspection. Those already known are: almond, apple, apricot, cherry, currant, fig, grape, live oak, olive, orange, peach and pear. The native host appears to be the live oak.

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[2] Injurious Insects of the Orchard, Vineyard, etc., 1883, p. 116.

[3] Insect Life, Vol. V, p. 34.

GENERAL NOTES.

THE INTRODUCTION OF CALOSOMA FOR USE AGAINST THE OAK MOTH.

During the past month the California oak moth, *Phryganidia californica*, has been doing very serious damage to oak in this State and especially in the Santa Clara Valley. Entire defoliation is a common occurrence, and with the coming on of the second brood very serious damage will probably be done, although this may be prevented by the attack of the native parasites which are sometimes sufficient to hold it in check. The recurrence of this moth every season has led us to believe that an attempt to introduce *Calosoma sycophanta* to prey on this worm would be well worth while. *Calosoma sycophanta* is a large green beetle very similar in appearance to our *Calosoma scrutator*, but is much more valuable for the reason that the larvæ of this imported beetle are more proficient in tree climbing. *Calosoma sycophanta* has been introduced by the U. S. Bureau of Entomology into New England for use against the gypsy moth, and this introduction has been an eminent success. It is probable that this beetle is, up to the present time, the most efficient of all of the introduced enemies of the gypsy moth. The credit for the successful outcome of the experiment in New England is due to Mr. A. F. Burgess and it is through his kindness and that of Dr. L. O. Howard, Chief of the Bureau, that we are supplied with a stock of these beetles for use in this State.

The insect is a native of South Europe, being found commonly in Southern France, Italy and Sardinia. While the gypsy moth is probably the food most preferred by *Calosoma sycophanta*, it also feeds voraciously on many other varieties of caterpillars, and there is but little doubt that it will find the California oak moth very much to its liking. The fact that this moth is present through a rather long season, it having more than one generation, and the similarity of our climate to that of the native habitat of this beetle, leads us to hope that it will thrive in California and become a valuable factor in the control of this pest. As oak trees are difficult to spray and as the operation is very expensive, we believe that this is one of the instances where no effort to obtain control through natural enemies should be spared. Besides the oak worm we have the fall-web worm, several species of tent caterpillars, several tussock moths, the canker worms and the red-humped caterpillars, all of which should form food for this beetle.—HARRY S. SMITH.

ARSENATE OF LEAD VS. PARIS GREEN.

For years, Paris green, and later London purple, were the almost exclusive arsenical poisons used to combat mandibulate or biting insects. Owing to the fact that the commercial acids were in part soluble they often blighted seriously the foliage of the plants that they were used to protect. Often it was impossible to use them strong enough to kill the insects without at the same time blasting the plants.

Prof. C. P. Gillette did a signal service when he discovered that by using four or five pounds of freshly slaked lime to each pound of the poison he could diminish the injury to the plants materially. This converts the soluble arsenious acid into an insoluble arsenite of lime. Yet this increased the work and was not always satisfactory.

Then came arsenate of lead. This can be used as strong as four pounds to one hundred gallons of water with no harm to the plants. The powdered article can be used often very effectively mixed with dry wood ashes, pound for pound. In this case a dust gun makes the work easy and rapid. In case the powder is used in lieu of the liquid a still day is necessary, and it is best applied when the plants are wet with dew.—A. J. Cook.

A TENEBRIONID BEETLE INJURING BEANS.

A small black Tenebrionid beetle, which has been identified by Dr. Chittenden of the Bureau of Entomology, as *Coniontis subpubescens*, has been found this season doing a great amount of damage on about 100 acres of beans near Oxnard. The adult beetles were found in large numbers feeding on the tender stocks just after they came through the ground. The stand of beans was almost completely ruined. While this beetle has been observed for some years in southern California, Dr. Chittenden advises the writer that this is the first report of damage done by it which has ever been received by the Department. Another of the common scavenger Tenebrionids (*Blapstinus* sp.) has been reported before, but not as being so severe in its work as is this one. The field attacked is some distance from other bean fields, and it does not appear that the pest will spread. It has also been observed that poison baits used for cutworms kill considerable numbers of these beetles when they are present in the fields, so that control in case it became necessary should be fairly simple.—R. S. Vaile.

MONTHLY CROP REPORT—JUNE.

These data are compiled by the secretary from monthly crop reports made by the county horticultural commissioners. Counties not included have not reported or the reports have come too late for preess. Unless otherwise designated percentages refer to last year's crop.

Alfalfa.

Reports still indicate a good crop of alfalfa throughout the State, although in a few sections the dry season will materially decrease the output.

Almonds.

10 per cent increase over report of last month in Contra Costa County and 60 per cent over last month's estimate of 10,800 pounds in Madera County. Ventura County reports an increase of 25 per cent over last month's report or a crop about equal to that of last year.

In other sections the conditions as reported last month have not changed materially.

Apples.

A 10 per cent increase over last month is reported from Butte County, while a 10 per cent decrease is reported from El Dorado County. A 5 per cent decrease shows on the report from Sacramento County. Shasta County reports from 50 to 60 per cent of last year's crop. Sonoma shows an increase of 5 per cent and Stanislaus a 25 per cent gain over last month's estimate.

In other sections the estimates of last month still appear accurate.

Apricots.

In Alameda County the conditions look better than the last report, showing an incrase from 50 as last reported to 75 per cent. Fresno County reports a gain of 50 per cent over last month's estimate. Madera reports 30 per cent of last year's crop (dried) of 64,000 pounds. Merced has only 10 per cent of normal crop. There is a decrease of about 60 per cent over last month's estimate for Monterey County. In Orange County the crop is only 30 per cent, but the fruit is in fine condition and will be of good size. There is a decrease of 15 per cent in the estimate of Sacramento County for this month, while San Bernardino has an increase of 5 per cent. Santa Cruz reports 70 per cent of full crop due to drought. Tehama County reports an increase of 50 per cent over last month's estimates, while Ventura reports a gain of 10 per cent.

Other counties report no material changes.

Beans.

Orange County estimates 80 per cent of a crop. Sacramento reduces last month's estimate from 100 per cent to 75 per cent of last year's crop. No other changes recorded. There are indications of a fair crop.

Berries.

A good crop reported throughout the State.

Cherries.

Practically all are harvested. There was a somewhat larger crop throughout the State than was estimated in last month's report, though a few sections fell short of it.

Figs.

In Butte County the first crop is heavier than usual. A much better crop is expected in Madera County than was reported last month. A large crop is also estimated for Merced County and a good crop for San Joaquin County. In Stanislaus County the crop is reported to be 25 per cent greater than last month's estimate and 15 per cent greater in Tulare County.

In other sections there have been no changes in the estimates.

Grapes (Wine).

Reliable estimates have been received relative to this crop and all indications point towards a fair yield throughout the State. Alameda reports but 50 per cent, Madera 115 per cent. A short crop is reported in Merced and San Joaquin counties, while Sonoma, San Bernardino, Sacramento, Los Angeles and Fresno report fair or good crops.

Grapes (Table).

Fresno, Los Angeles, Madera, Stanislaus and Sonoma report full crops. Tulare, Sacramento and San Bernardino report 90 per cent, while San Joaquin estimates a short crop.

Hops.

All reports so far received indicate that the hop crop will be about the same as that of last year.

Lemons.

There appear to be no improvements in the prospects for a lemon crop over those given in last report. If anything it will be slightly less than was estimated at that time.

Olives.

Butte—75 per cent. *Madera*—150 per cent. *Merced*—full crop. *Orange*—80 per cent of crop which is double that of last year. *Sacramento*—90 per cent. *San Bernardino*—95 per cent. *Stanislaus*—150 per cent. *Tehama*—100 per cent. *Tulare*—75 per cent. In other sections the former estimates remain unchanged.

Oranges.

Butte—50 per cent. *Los Angeles*—twice the crop of last year which was very short. *Orange*—80 per cent. Navels set well—about 90 per cent. Valencias dropping and will be about 70 per cent of last year. *Riverside*—65 per cent of normal. *Sacramento*—95 per cent. *San Bernardino*—70 per cent. *Sonoma*—50 per cent. *Tehama*—100 per cent. *Tulare*—65 per cent. *Ventura*—shipping heavily of Valencias now. Good setting. Other estimates remain the same.

Peaches.

Alameda reports an increase of 5 per cent over last month's estimate. *Contra Costa*—reports half a crop. *El Dorado*—60 per cent. *Lake*—40 per cent. *Madera*—100 per cent. *Merced*—40 per cent. *San Bernardino*—95 per cent. *San Joaquin*—two thirds normal crop. *Shasta*—25 per cent to 30 per cent. *Sonoma*—65 per cent. In other counties there is no change over last month's estimates.

Pears.

Alameda—75 per cent. *Butte*—shows a slight increase over last month. *Contra Costa*—50 per cent. *El Dorado*—50 per cent. *Lake*—60 per cent. *Mendocino*—50 per cent. *Santa Cruz*—80 per cent. *Shasta*—40 to 60 per cent of crop. Other counties report no change of last month's estimates. Most of the localities show an increase over last report indicating a better crop than was at first expected. The quality of the fruit will be excellent.

Plums.

In Alameda County the crop will be about 45 per cent because of the dry season. *Sonoma*—reports an increase of 5 per cent over last report. *Stanislaus*—gains from 35 to 75 per cent. *Tulare*—60 per cent instead of 50 per cent. Other counties report same as last month. A very good crop is assured.

Potatoes.

The crop throughout the State will be from 75 to 90 per cent of last year's according to all estimates received.

Prunes.

The prune situation has not materially changed. Though only about half that of last year the sizes and quality are exceptionally good.

Walnuts.

Alameda—75 per cent. *Los Angeles*—75 per cent. *Merced*—full crop. *Orange*—120 per cent. Nuts beginning to drop, though blight does not appear to be severe. *Riverside*—100 per cent. *Sacramento*—80 per cent. *San Bernardino*—100 per cent. *San Joaquin*—good crop. *Stanislaus*—150 per cent. *Tulare*—60 per cent. *Ventura*—90 to 95 per cent. Very little blight. Other localities remain as last reported. The blight is reported to be less in evidence than in many years. A good clean crop is apparently assured.

General Summary of California Crop Conditions.

The following estimated conditions on June 1, 1913, with comparisons of the principal crops in California, on the basis of 100 representing a normal crop, is reported by the Crop Reporter of the U. S. Department of Agriculture, as follows:

	1913.	1912.	1911.
Apricots	68	85	57
Almonds	55	85	67
Prunes	73	88	69
Olives	87	92	93
Walnuts	77	88	81
Oranges	70	90	97
Lemons	60	88	95

GENERAL CROP CONDITIONS.

The Pacific Northwest.

Reported by the Northwestern Fruit Exchange.

Oregon: (Rogue River Valley).

Apples—Some apple trees that bore heavily in 1912 will only have half crop. Young orchards will more than make up the shipment of last year or 550 cars.

Pears—A 25 per cent increase is expected or 400 cars.

Peaches—75 per cent of normal crop.

Prunes—80 per cent of normal crop. This estimate takes into consideration a loss by frost of approximately 60,000 boxes.

(Williamette Valley.)

Apples—Most of the apples in this district are used locally and in by-products. Outside shipment will not exceed 100 cars. Crops will be lighter than last year.

Pears—Average crop will be normal.

(Hood River District, including Mosier, White Salmon and the Dalles.)

Apples—This is the off year for some old orchards, but younger orchards are expected to bear enough to bring total crop up to that of 1912, or around 1,200 cars.

Prunes—Normal crop.

(Eastern Oregon.)

Apples—This will be an off year for Ben Davis, Gano and York Imperials while Rome Beauty and some other varieties will show an increase, probably an average of 75 per cent of 1912 crop. No frost damage.

Pears—Two thirds crop on account of too much rain while blooming.

Prunes—Half crop. *Cherries*—Full crop.

Washington: (Wenatchee District).

Apples—4,328 cars as against 3,495 in 1912.

Pears—139 cars as against 200 in 1912.

Peaches—410 cars as against 491 in 1912.

Apricots, Plums and *Cherries*—732 cars or 78 per cent of normal.

(Yakima Valley.)

Apples—A great many trees bore so heavily last year that they did not bloom this year. Probable crop 60 per cent of 1912 or 3,000 to 4,000 cars.

Pears—Frost damage will reduce this year's crop to about 200 cars.

Peaches—Some frost damage reported, but not very general, and there may be 1,500 cars this year.

Prunes—Will be light crop, probably less than 100 cars.

Cherries—Half crop on account frost. Probably 20 cars.

(Walla Walla.)

Fruit crop expected to nearly equal crop of 1912.

(Dayton-Waitsburg.)

50 per cent of normal or 80 cars of apples. Other fruits heavy crops.

(Spokane District.)

Apples—Damaged by frost in some spots. Crop will be lighter than 1912.

Other States and Canada.

Reported by the Northwestern Fruit Exchange.

In condensed form, we give the reports at hand, most of which were written within the last two weeks. We again state that this report can not be considered as an absolute prediction as many conditions are bound to change from month to month, and of these changes, we will endeavor to keep you informed. As an off-hand summary, we may note that the apparent net decrease is only 6,000 to 8,000 cars of apples, or about 3 1-3 per cent of the 1912 crop.

Arkansas:

Apples generally bloomed full. Jonathan not setting well. Ben Davis light.

Peaches—Southern part of the state has full crop. In Benton and Washington counties, crops will be above normal. Around Fort Smith and Van Buren, crop reduced to 50 per cent. Other districts 70 to 90 per cent. State may average 70 per cent.

Canadian Provinces:

Apple prospects are generally optimistic.

Pear growing sections report conditions very favorable.

Nova Scotia 1912 was off year, 5,000 cars. 8,000 cars expected 1913.

British Columbia *apple* crop above normal in 1912. 80 per cent of last year's crop expected for 1913.

Pears—110 per cent of last year expected.

Peaches—Some lighter than last year.

Prunes—85 per cent of last year's crop.

Colorado—Western slope:

Apples—Spring frost reduced crop to 50 per cent or 1,200 to 1,500 cars.

Pears—Spring frost damaged crop one half.

Peaches—Winter freeze and spring frost did great damage. Prospect not over 50 per cent crop, or 900 cars.

Eastern part:

Apples—Prospects are good for double the 1912 crop. 1,000 cars of apples are expected.

Pears—Double 1912 crop expected. *Peaches* likewise.

Connecticut:

Apples—The 1912 crop was light, but we have had a very favorable season so far. Expect 250 per cent of crop or 3,500 cars.

Peaches in this state and all New England will be a big crop or 300 per cent of last year's crop, notwithstanding some damage by frosts

Delaware:

Apples—Expect 40 per cent crop.

Peaches—Expect about 40 per cent crop.

Pears—About 25 per cent of full crop expected.

Florida:

Normal crop *oranges;* a little short on *grapefruit.*

Georgia:

Apples—Expect a record crop for the state, or three times last year's.

Peaches—Estimates of crop vary from 1,300 cars to 2,500 cars. Probably the closest estimate is around 1,800 to 2,000 cars.

Indiana:

Apples—Expect larger crop than last year except Ben Davis. Many conditions are unfavorable. Commercial orcharding in the state does not amount to much.

Illinois:

Apples—Promise the largest crop in twenty years, although in restricted areas there has already been a severe drop on account poor pollenization and twig blight.

Idaho:

Incomplete reports indicate normal crops for the state.

Iowa:

Apples—65 to 90 per cent of normal crop. Considerable loss caused by canker worms. *Pears* promise nearly a full crop.

Louisiana:

Peaches—50 to 75 per cent of normal crop expected.

Michigan:

Apples—Normal crop of 8,000 to 10,000 cars expected.

Pears—75 per cent crop in sight or 1,500 cars. (Damage by frost.)

Peaches—May frosts reduced the crop approximately one third. Crop now expected 3,500 cars.

Missouri: (Calhoun County).

Apples—Ben Davis will be around a half crop. Others nearly normal. As Ben Davis is about half of all grown, the total crop will be reduced about 25 per cent, leaving prospect of 900 cars.

Peaches—In the Ozarks, full crop. Elsewhere in the state averages more than 1912.

Montana:

Apples—A full crop expected or 500 cars. Some older orchards show a decrease, but new ones make up for it.

Nebraska:

Apples—Crop will be about same as last year or 1,500 cars. Jonathans are heavy while Winesaps and Ben Davis are light.

New Jersey:

Apples—Prospect for heavy crop throughout state.

Pears and *Plums*—Very light.

Peaches—Damaged 30 to 40 per cent by frosts.

New Mexico:

Apples—200 per cent of last year's crop or 1,200 cars.

Pears—200 per cent of last year's crop or 200 cars.

Peaches—200 per cent of last year's crop or 400 cars.

Prunes—200 per cent of last year's crop or 100 cars.

North Carolina:

There has been a heavy drop on nearly all kinds of fruit.

Apples will be a 40 per cent crop.

Pears will be a 15 per cent crop.

Peaches will be a 68 per cent crop.

Ohio:

Apples—There will be plenty in the northwestern part of the state, or Lake District, which is the principal fruit growing district. Central and eastern Ohio was hard hit by the May freeze, and practically all fruit was killed.

Oklahoma:

Apples—Full crop expected.

Pears and *Peaches*—Light crops expected.

Pennsylvania:

Apples—Last year's crop was light. This year the bloom was very heavy, but sets have dropped somewhat. Indications are for 150 per cent crop as compared with 1912, or 3,500 cars.

Peaches—Will be light and all be consumed in the state.

New York:

Apples—Western New York raises principally Baldwins and this variety will be light crop following big crop of 1912. All other varieties heavy crop, especially Greenings. No damage of note by frost. Size and general quality expected to be better than ever. Average crop may be 85 per cent of last year.

Pears—Heavy crop—200 per cent of last year.

Plums—Fair crop.

Peaches—About 50 per cent of last year, but up to normal average.

Cherries—Damaged in some localities.

Grapes—Damaged to some extent.

INSECT NOTES.

Mr. Harry S. Smith, superintendent of the State Insectary, has received a small weevil from Mr. Richard Baird of Inyo County, who reports it as doing considerable damage to the buds of apples during the past spring just as they are opening. Dr. Van Dyke determined the weevil as *Eupagoderes mortivallis.* It is considerd as a rather rare form.

This spring the onion thrips, *Thrips tabaci* Lind., has been found attacking cantaloupe vines. All stages of the insect occurred on the vines and produced a mottled effect on the upper surface of the leaves. It was found generally distributed throughout the Brawley district, but only serious in a few small patches. Onion fields are generally infested—some of them severely so.

The large light-colored, circular scale so common on the foliage of the manzanita in the higher altitudes of the Sierra Nevada Mountains has been described as a new species, *Aulacaspis manzanitæ,* by B. B. Whitney, state quarantine inspector at San Francisco. This scale is often mistaken by the growers in those regions for San Jose and other orchard scales.

The pear slug, *Caliroa cerasi* Linn., is reported by certain growers to be unusually abundant along the Sacramento this season.

The alfalfa caterpillar, *Eurymus eurytheme* (Boisd.), is doing some damage to alfalfa in Imperial County.

Many specimens of the common grain thrips, *Euthrips tritici* Fitch, have been received from growers who feared damage would be done to the alfalfa fields. This insect is exceedingly common and abundant in the blossoms of alfalfa, but so far has not been reported as doing any considerable damage to the crop. It is especially abundant in the Imperial Valley and other sections in the southern part of the state, and is easily recognized by the orange-colored thorax.

The small scarabæid beetle, *Serica alternata* Lec., is quite abundant along the beach at Ventura, Califorina. S. H. Essig collected great quantities of it there during the middle of May.

The red-humped caterpillar, *Schizura concinna* S. & A., has already appeared in many districts of the Sacramento Valley. Prompt sprayings with arsenate of lead form a ready means of controlling this pest.

The raspberry horntail, *Hartigia cressoni,* is doing considerable damage to loganberries, roses, blackberries and raspberries in the vicinity of Sacramento.

The grasshopper which has been doing much damage in the Sacramento valley this spring proves to be the devastating grasshopper, *Melanoplus devastator conspicuus* Scudd. Its ravages have been particularly severe in some orchards.

Mr. G. P. Weldon, chief deputy commissioner, reports cicadas quite abundant in an olive orchard near Chico. The adult insects were puncturing the small twigs and depositing their eggs therein. The species has not yet been identified.

A small weevil has been collected in Ventura County by S. H. Essig, who, with Mr. Vaile, horticultural commissioner, reports it doing considerable damage to the foliage of apricot trees in Ventura County. The leaves and tender twigs are attacked.

A small yellow scale, *Aspidiotus britannicus* Newst, has been found abundant on the leaves of imported bay trees from Holland.

E. J. Vosler, assistant superintendent of the State Insectary, has returned from a two weeks' scouting trip for the alfalfa weevil, *Phytonomus posticus* Gyll. The alfalfa fields along the Salt Lake Route in the Mojave Desert between Daggett and Victorville were thoroughly examined, but fortunately no trace of this pest could be found. This newly settled region which is mainly watered by pumping plants has an acreage in alfalfa of approximately 500 acres. The alfalfa fields in the Imperial Valley were also examined with a negative result.

He also reports that in the Imperial Valley little damage is being done to the melon vines by the melon aphis, *Aphis gossypii* Glover. The practice has been to destroy the infested vines by burning, as soon as the aphis is detected. The melon season for the valley closed about July 15th.

NOTES FROM THE COUNTY COMMISSIONERS

Glenn County.

Mr. Carl J. Ley has been conducting successful control measures against grasshoppers, which have been quite plentiful in his county.

Humboldt County.

Mr. George B. Weatherby reports considerable damage to loganberry bushes by a leaf miner.

Imperial County.

The supervisors have asked the state board of horticultural examiners for an examination to qualify eligibles for county horticultural commissioner. Due to his many other duties Mr. Wilsie is unable to continue in this office.

Kings County.

Mr. B. V. Sharp has been unable to assume his duties during the past few months because of sickness. We are happy to hear of a gradual improvement in his condition.

Merced County.

Mr. W. H. Wilson, after quite a long illness, has again resumed active work in his county, beginning with a campaign against the Russian thistle.

Shasta County.

Mr. George Lamiman has reported good success in the destruction of grasshoppers by burning.

Tulare County.

Mr. A. G. Schulz reports mildew as doing considerable damage to peaches over small areas in his county.

QUARANTINE DIVISION.

Report for the month of May, 1913.

By Frederick Maskew, Chief Deputy Quarantine Officer, San Francisco.

SAN FRANCISCO STATION.

Horticultural imports.

		Parcels.
Ships inspected	43	
Passed as free from pests		78,963
Fumigated		1,625
Destroyed		138
Returned		10
Contraband		76
Total parcels horticultural products for the month		80,812

Pests intercepted.

From Honolulu—
- *Diaspis bromeliæ* and *Pseudococcus* sps. on pineapples.
- *Cylas formicarius* and *Omphisa anastomosalis* in sweet potatoes.
- Aphids on betel leaves.
- Larvæ of *Ceratitis capitata* in tomatoes.
- Larvæ of *Dacus cucurbitæ* in cucumbers.
- *Hemichionaspis minor* and *Aspidiotus lataniæ* on plant sps.

From Japan—
- Eggs of *Bruchus* sps. in seeds.
- *Aulacaspis pentagona* on peach, cherry and rose.
- *Aspidiotus* sps. on juniper.
- *Pseudaonidia pæoniæ* on azaleas.
- *Pseudaonidia duplex* on camellia.
- *Parlatoria ziziphus* on maple.
- *Pseudococcus* sps. and *Aphis* sps. on pine tree.
- *Parlatoria pergandii* on camellia.
- *Chionaspis citri* on orange.
- *Aleyrodes citri* on citrus trees and gardenias.

From Florida—
- *Diaspis bromeliæ* and *Pseudococcus* sps. on pineapples.
- *Lepidosaphes beckii*, *Parlatoria pergandii*, *Phomopsis citri* and *Leptothyrium pomi* on grapefruit.

From New York—
- *Diaspis boisduvalii* on orchids.

From England—
- *Coccus hesperidum* and *Diaspis boisduvalii* on orchids.

From Belgium—
- *Coccus hesperidum* and *Aspiodiotus britannicus* on bay.

From Papeete—
- *Aspidiotus lataniæ* on sapotes.

From Manila—
- Weevils in palm seeds.

LOS ANGELES STATION.

Horticultural imports.

		Parcels.
Ships inspected	19	
Passed as free from pests		73,468
Fumigated		1,442
Destroyed		1
Returned		0
Contraband		0
Total parcels horticultural products for the month		74,911

Pests intercepted.

From Belgium—
- *Coccus hesperidum* and *Aspidiotus britannicus* on bay.
- *Orthezia insignis* on evergreen.
- *Hemichionaspis aspidistræ* on Aspidistra lurida.

From Cuba—
- *Pseudococcus* sps. on pineapples.

From Florida—
- *Eucalymnatus perforatus*, *Ischnaspis longirostris*, *Chrysomphalus ficus*, *Chrysomphalus aurantii* and *Aleyrodes* sps. on mango.
- *Eucalymnatus perforatus* on palm.
- *Pseudococcus citri* on croton.
- *Pseudococcus* sps. on pineapples.

From Germany—
- *Pseudococcus* sps. on cactus.

From Holland—
- *Lepidosaphes ulmi* on boxwoods.
- Aphids on Norway pines.

From Massachusetts—
- *Pseudococcus citri* on ferns.

From New Jersey—
- *Pseudococcus citri* on acacia.

From Pennsylvania—
- *Chrysomphalus aurantii* on palm.

From Texas—
- *Lepidosaphes beckii* on pomelo.

From Turkey—
- *Phœnicococcus marlatti* and *parlatoria blanchardii* on date palms.

SAN DIEGO STATION.

Horticultural imports.

		Parcels.
Ships inspected	14	
Passed as free from pests		1,984
Fumigated		3
Destroyed		3
Contraband		5
Total parcels horticultural products for the month		1,995

Pests intercepted.

From Ohio—
- *Pseudococcus* sps. red spider, *Aleyrodes* sps. and *Coccus hesperidum* on citrus plants and camellia.
- *Orthezia insignis* on lantana.
- *Pseudococcus longispinus* on poinsettia.
- *Aleyrodes citri* on citrus stock.
- *Aleyrodes* sps. on hibiscus.

SANTA BARBARA STATION.

Ships inspected ---------- 2

No horticultural imports.

EUREKA STATION.

Ships inspected ---------- 4

No horticultural imports.

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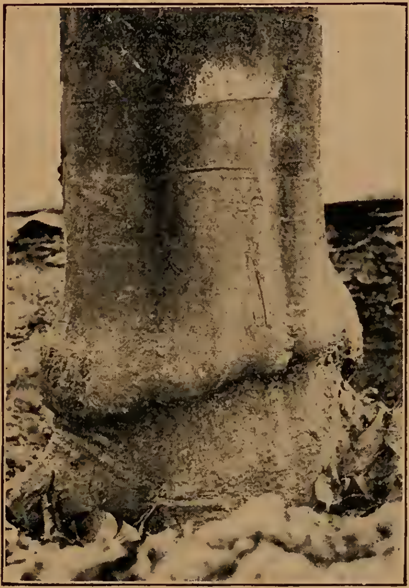
VOLUME II No. 8

THE MONTHLY BULLETIN



Gummosis produced upon healthy lemon tree by inoculation from tree infected with the disease. (Photo by H. S. Fawcett.)

OF

STATE COMMISSION OF HORTICULTURE

SACRAMENTO, CALIFORNIA AUGUST, 1913

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STATE COMMISSION OF HORTICULTURE

August, 1913

THE MONTHLY BULLETIN

VOLUME II No. 8

DEVOTED TO THE DESCRIPTIONS, LIFE HABITS AND METHODS OF CONTROL OF INSECTS, FUNGOID DISEASES AND NOXIOUS WEEDS AND ANIMALS, ESPECIALLY IN THEIR RELATIONS TO AGRICULTURE AND HORTICULTURE.

EDITED BY THE ENTIRE FORCE OF THE COMMISSION UNDER THE FOLLOWING DIRECTORS:

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SACRAMENTO, CALIFORNIA
1913

TWO FUNGI AS CAUSAL AGENTS IN GUMMOSIS OF LEMON TREES IN CALIFORNIA.

(*Botrytis vulgaris* and *Pythiacystis citrophthora.*)

By H. S. FAWCETT, Plant Pathologist, State Commission of Hortculture, Whittier, Cal.

Introduction.

The term "Gummosis," or lemon gum disease, will be restricted in this article to that condition described by Professor R. E. Smith and O. Butler, in Bulletin 200, of the California Experiment Station. It is characterized by dying of areas of bark, accompanied by the exudation of gum, usually somewhere on the trunk from above the bud union to the forks of the branches. The word Gummosis, as used by Professor Smith, and as used here, does not apply to the formation of gum in the small branches, leaves or fruit, nor to mere gumming that is entirely unaccompanied by dying of bark. Mere gum formation in citrus trees may take place as a result of chemical stimuli or other causes, but this is not included under the word gummosis. In some respects, it would be better to use for this disease a term such as "bark rot," since the dying of the bark rather than the formation of gum is what results in serious injury and justifies the term "disease." Gummosis is a definite disease, mere gum formation alone is not a sign of any one specific disease, but since misunderstanding is likely to arise in making changes in names, the term Gummosis, expressing a definite result of the disease rather than the cause, had best be retained. That at least two forms of this disease are induced in healthy trees by two fungi (commonly known in the packing-houses as the brown rot fungus and the grey fungus) have been discovered as the result of a series of experiments during the past year.

The commonly held view that all forms of this disease in California were physiological, and that they were due to some deranged condition of the tree itself, brought about entirely by unfavorable soil, climatic or cultural conditions, was a natural inference from the commonly observed fact that the larger percentage of the cases of gummosis occurred where unfavorable soil or cultural conditions existed, such as poor drainage, soil above the bud union, excessive amount of water, etc. So well was this relation between unfavorable conditions and gummosis recognized by growers and those previously studying this disease that fairly successful methods of dealing with it had been worked out by them and put in practice by some of the most successful orchardists. The work previously done by Professor R. E. Smith* and others in obtaining a thorough understanding of the causal conditions (poor drainage, soil above the bud union, etc.) served as an excellent basis on which to carry further the work in determining some of the causal agents (the fungi). It would seem now that the success of the methods employed in preventing gummosis was due to the bringing about of conditions that were unfavorable either to the infection by the causative agents or to their development, or to both. These recognized methods of prevention are important and can not be emphasized too strongly. Keeping the soil away from the bud union, getting good drainage, using sour orange stock for heavy soils, using high budded lemon trees planted high for all new plantings, are important precautions that should not be neglected.

---

*Smith, R. E., and Butler, O., Gum Diseases of Citrus Trees, California Experiment Station, Bulletin 200, 1907.

It remained true, however, that in spite of all the care that could be exercised, certain cases of gummosis kept recurring, which appeared not to be accounted for merely on the ground of unfavorable soil and cultural conditions. While the avoidance of these unfavorable soil and cultural conditions was recognized by all growers as extremely important in preventing the disease, and while the usual treatment of slitting and painting with pure neat's-foot oil appeared to be successful in some places, a number of growers felt that this treatment was inadequate, and that the use of impure neat's-foot oil had injured many trees.

The writer had, while in Florida, with the help of Mr. O. F. Burger, proved that a gumming of orange and peach trees, accompanied by killing of the bark and wood, was induced by a fungous growth, *Diplodia natalensis*.[1] On coming to California he was confronted with the question as to whether fungi might not also play a part in gummosis of lemon trees. It was well known that gumming took place in connection with the attack of the peach blight fungus *Coryneum beyerinkii*.[2] A form of gumming of cherry trees in Oregon had recently been reported as due to a bacterium.[3] A number of fungi had been reported, also, as causing gumming of peach, apricot and citrus trees in foreign countries.

Professor Ralph E. Smith, at the Southern California Pathological Laboratory, in talking the situation over with the writer, suggested that further work be taken up on gummosis and other similar troubles, to determine whether or not organisms had any relation to them. It was for this reason and also because of the promise of hearty co-operation by several growers that the work was first taken up in February, 1912.*

---

[1] Mycologia III, 151–153; also Annual Report of the Florida Agricultural Experiment Station for 1911, pp. 61–65, and same for 1912, pp. 77–81.

[2] Smith, R. E., California Peach Blight, Bul. 191, California Experiment Station, 1907.

[3] Griffin, F. L., Science N. S. 34, p. 615, November, 1911; Barrs, H. P., Cherry Gummosis. Biennial Crop Pest Report for 1911–1912, Oregon Agricultural Experiment Station.

*To Mr. J. D. Culbertson, of the Limoneira Ranch, Mr. R. S. Vaile, County Horticultural Commissioner of Ventura County, and to Mr. J. A. Prizer, of the San Diego Fruit Company, is due the credit for having suggested and for having helped initiate the experiments on which the results hereafter described are based. The success of the work is also due to the hearty co-operation of Mr. C. C. Teague, of Santa Paula, Mr. J. E. Boal, of National City, and Mr. L. B. Barnes of Chula Vista, who were instrumental in furnishing valuable trees and facilities for carrying on the work. The Southern California Pathological Laboratory at Whittier, through Professor R. E. Smith and his staff, aided and encouraged the work most generously by furnishing room and allowing the use of valuable apparatus and other facilities. The Citrus Experiment Station at Riverside, through Dr. J. E. Coit, also furnished a number of trees for one series of inoculation experiments. Help was also given freely by many others, especially by Mr. Milo Hunt, of Whittier, in furnishing a number of valuable nursery trees for some of the experiments. Mr. John King, of Whittier, also furnished a few citrus trees for one of the experiments.

Lines of Investigation.

Was gummosis infectious? Inoculations were first made to determine either the infectious or non-infectious nature of certain forms of gummosis. Cuts were made into the bark of large, healthy lemon trees and bits of material from diseased trees inserted. It was found that typical cases of gummosis (the dying of large areas of bark and the exuding of gum) could be induced on perfectly healthy lemon trees in three to four months by bits of discolored bark or wood taken from the advancing edges of diseased areas of naturally occurring cases of gummosis. Bits of exuded gum or pieces of tissue already permeated with gum from these same trees failed to transmit the disease when placed in cuts in the bark of healthy trees. This result appeared to explain why inoculation by previous workers had failed. The infectious principle was not in the gum itself, but in the diseased bark and at the margins of the enlarged areas, and therefore inoculation with the gum alone had failed to transmit the disease. It was also found that the younger the trees the more resistant they seemed to be to the effect of inoculations. Young nursery stock could readily be induced to gum, but usually healed up again without further progress of the disease. In older trees, however, the gumming continued and the area of killed bark slowly increased.

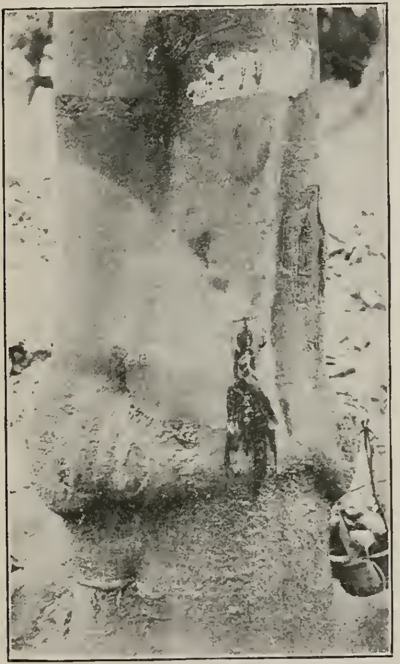

FIG. 340.—Lemon tree inoculated by inserting under the healthy bark a bit of gummosis bark from a diseased tree March 8, 1912; photographed June 27, 1912, to show exuding gum. (Original.)

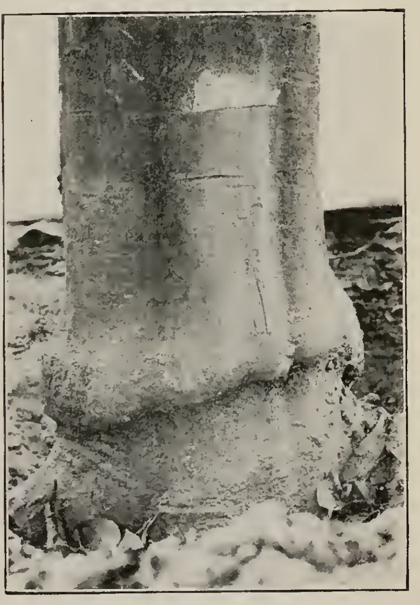

FIG. 341.—Opposite side of same tree shown in Fig. 340: bark cut without intion of diseased tissue. (Original.)

Fig. 340 shows the beginning stages of gummosis from one of the inoculations with diseased bark in a healthy eighteen-year-old lemon tree. Fig. 341 shows a cut not inoculated in the opposite side of the same tree, which has healed perfectly. This tree was inoculated at Santa Paula March 8, 1912, by inserting a small bit of bark from a diseased tree. The photograph was taken on June 27th, over three months later. By November the bark was killed over an area of six inches long and three inches wide, and gum was running out four inches farther up than in the illustration. At the present time the area of killed bark is nine inches long and four inches wide, but the cut (Fig. 341) on the opposite side is closed with healthy new bark.

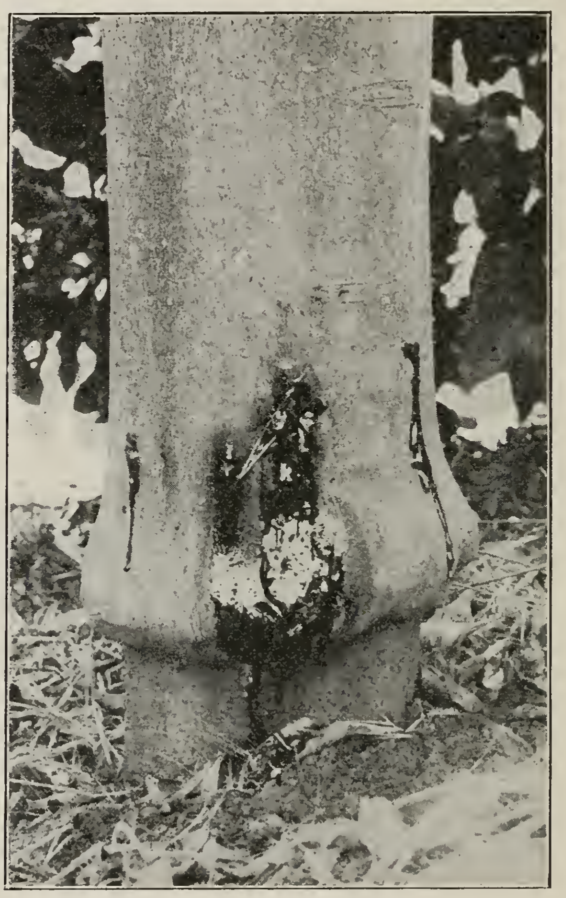

FIG. 342.—Lemon tree inoculated by insertng into healthy bark a bit of diseased bark from another tree nearly dead with gummosis February 27, 1912. Photographed August 2, 1912, to show the characteristic infection. (Original.)

Figures 342 and 343 show a more rapid development of gummosis as the result of inoculation with diseased bark into a healthy tree at Chula Vista, and is a form of gummosis different from Figure 340. The tree shown in Figure 342 was inoculated on February 27, 1912, with a bit of bark from a tree just about to die. It was first noticed to be gumming on May 24th. Figure 342 was photographed August 2d, and Figure 343 September 19, 1912. The leaves on the side of the tree which was gumming showed a decided yellowing, while the other side was still green. By March 11, 1913, there was left only four inches of live bark on the opposite side. Cuts into other trees inoculated with healthy bark healed perfectly without gumming. Many other trees inoculated at the same time and also at later dates with diseased tissues were similarly affected.

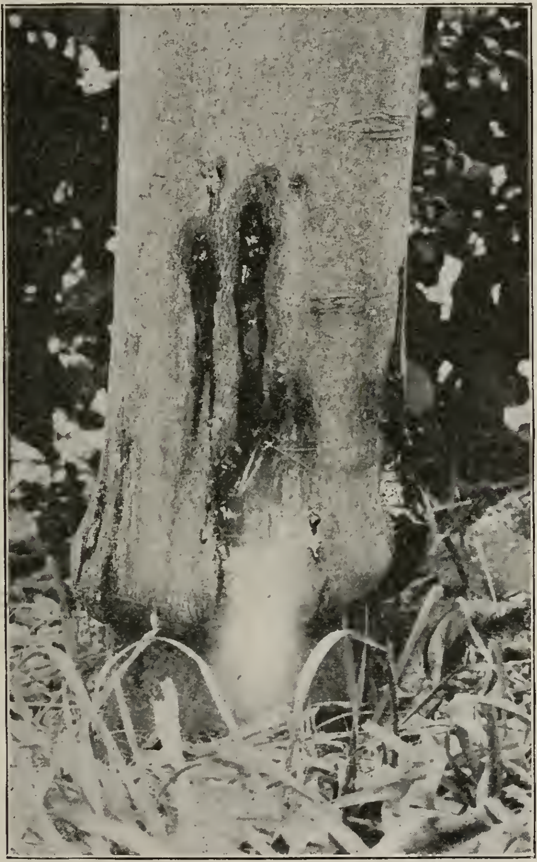

FIG. 343.—Same tree as in Fig. 342 photographed September 19th to show the rapid progress of the disease. (Original.)

The Causal Agents: Having found that the disease was transmissible, the next step was to find out what the agent or agents were that were capable of transmitting it. In making the first studies of lemon gummosis in the orchards it had been noticed that there were at least two forms of the disease: one in which the outer layer of bark was killed much in advance of the inner and in which there was some softening of the bark, and another in which the killing of the inner bark lagged only slightly behind that of the outer and in which the bark remained hard as the areas of infection enlarged. As will be shown later, the former is caused by the grey fungus (*Botrytis vulgaris*) and the other by the brown rot fungus (*Pythiacystis citrophthora*), both commonly known as causing fruit rots in the citrus orchards and packing-houses of California.

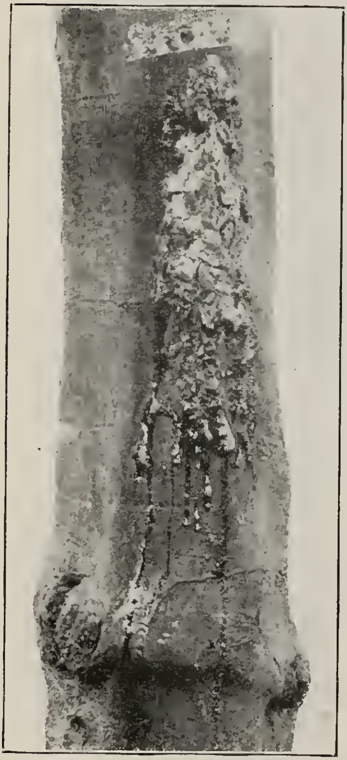

Fig. 344.—Lemon tree inoculated by inserting bit of grey fungus (*Botrytis*) into the bark March 8, 1912. Photographed July 13, 1912. (Original).

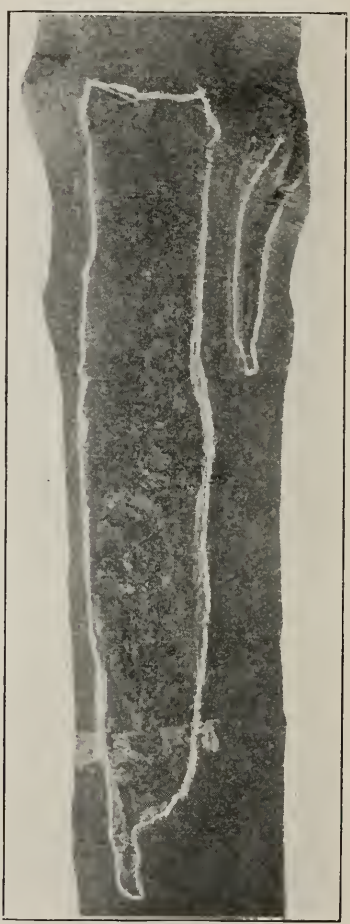

Fig. 345.—Same tree as in Fig. 344. Photographed May 10, 1913, nearly 11 months later, showing by chalk lines the area of infected bark. A large part of the gum had been dissolved by spring rains. (Original.)

Grey Fungus (Botrytis) Gummosis.

After the rains of March, 1912, attention was called to the grey fungus (*Botrytis*) growing abundantly on the dead bark of gumming lemon trunks at Santa Paula, especially where neat's-foot oil had been used.

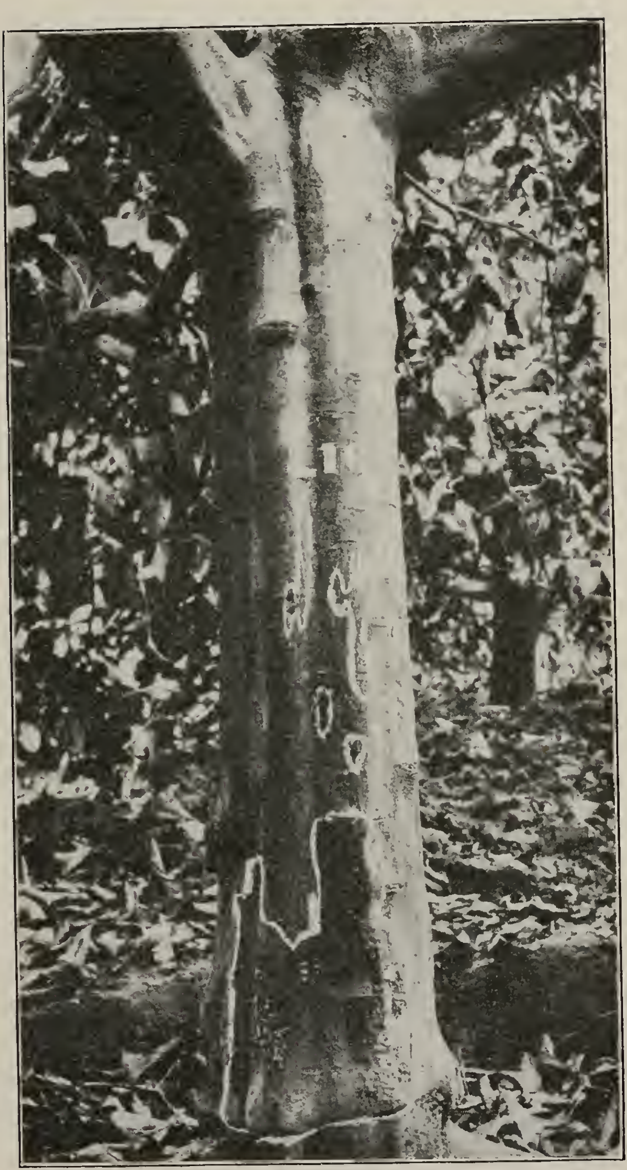

FIG. 346.—Lemon tree inoculated by inserting the grey fungus (*Botrytis*) into healthy bark, March 8, 1912. Photographed February 22, 1913, showing area of killed bark outlined with chalk. (Original.)

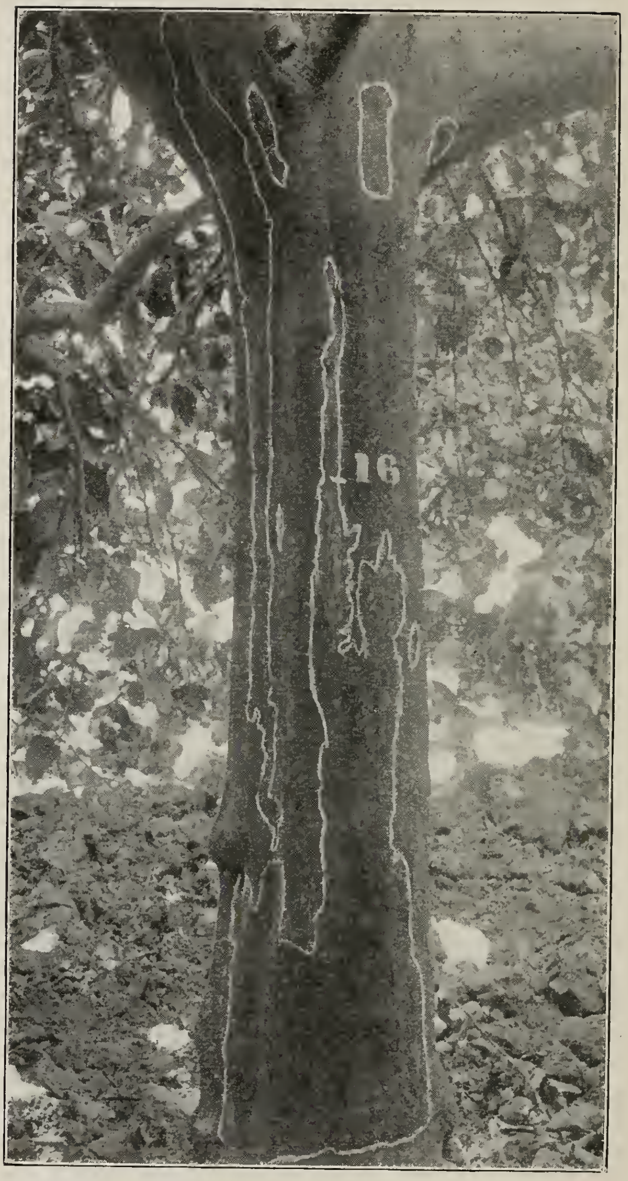

FIG. 347.—Same tree as shown in Fig. 346. Photographed May 10, 1913, to show the spread of the diseased areas. (Original.)

On March 8, 1912, inoculations were made with this fungus, taken directly from the bark and inserted into cuts in healthy trees. Pure cultures were obtained from these diseased trees and used in later inoculations.[1]

Figure 344 illustrates the result of an inoculation into the bark of a healthy tree with grey fungus (*Botrytis*), which had been taken directly from diseased bark. The inoculation was made March 8, 1912. The tree was photographed to illustrate the stage of the disease on July 13th. Figure 345 shows the area of killed bark, outlined by a white mark, on May 10, 1913, about one year and two months after inoculation.

The bark of the tree shown in Figures 346 and 347 was also inoculated with *Botrytis* fungus at the same time as Figure 344. It had begun to gum by June 15th. It had gummed copiously during the summer of 1912, an area of bark six inches long and five inches wide being killed by November. A ridge of gum five inches long and one and one half inches wide had formed on the killed area at that time. The disease appeared to be dormant during the fall, no new gum being formed, but it began to spread again later.

Figure 346 shows the outline of the diseased area of bark on February 22, 1913, and Figure 347 on May 10, 1913, showing how the areas of infection have merged. A cut in the bark without inserting fungus on the opposite side of this same tree has healed perfectly. A number of other inoculations with the same fungus at the same time developed similarly, while cuts in the opposite side of the same trees without fungus healed perfectly.

A few months later inoculations were made into the bark of healthy trees with pure cultures of the grey fungus (*Botrytis*) which had been isolated from the diseased bark of gummosis trees.[2] The same type of gummosis developed from these inoculations made with pure cultures under careful control as had previously developed under less careful conditions, but all kinds of injuries when kept sterile healed rapidly without gumming. The outer part of the bark in inoculations with *Botrytis* was killed first over large areas, the cambium remaining active and alive for some time. When the fungus became quite active, especially during moist weather, the bark softened and died to the wool, and the fungus produced raised cushion-like patches of grey spore-covered bodies on the surface. In dry weather there was usually no visible evidence of fungus.

---

[1] In May, 1911, of the previous year Mr. R. S. Vaile and Mr. J. D. Culbertson had inserted under the bark of healthy trees, bits of diseased bark showing a growth of grey fungus upon it. Mr. Vaile's notes show that of five inoculations all produced some gum in from three to six weeks, and that the fungus had developed most rapidly on bark covered with neat's-foot oil.

[2] It was a problem how to make inoculations or injuries into tree trunks in the open and keep them free from organisms that might get in from the air or dust. In attempting to overcome this difficulty the following method was adopted for the most important of these inoculations: A cloth hood to be tied to the tree trunk was made by fastening a piece of fumigated tent cloth to a wooden barrel hoop cut open on one side. Strings were fastened to the cut ends of the hoop and to the corners of the cloth opposite the hoop. The strings opposite the hoop were tied to the trunk of the tree just below the branches and the hoop fastened below in such a way that it caused the cloth to flare out and leave a place underneath protected from falling dust and excessive currents of air. To settle the dust in dry weather the under surface of the hood, the trunk of the tree and the soil about the base was sprayed with water. The area of bark to be experimented on was then washed first with water, then with alcohol and quickly flamed with an alcohol lamp. The instruments used were either sterilized by heat or by alcohol which had been allowed to evaporate from their surfaces. Some of the inoculations were protected by wax, some with oiled paper waxed about the edges, and others with sterile microscopic glass slides held on with putty.

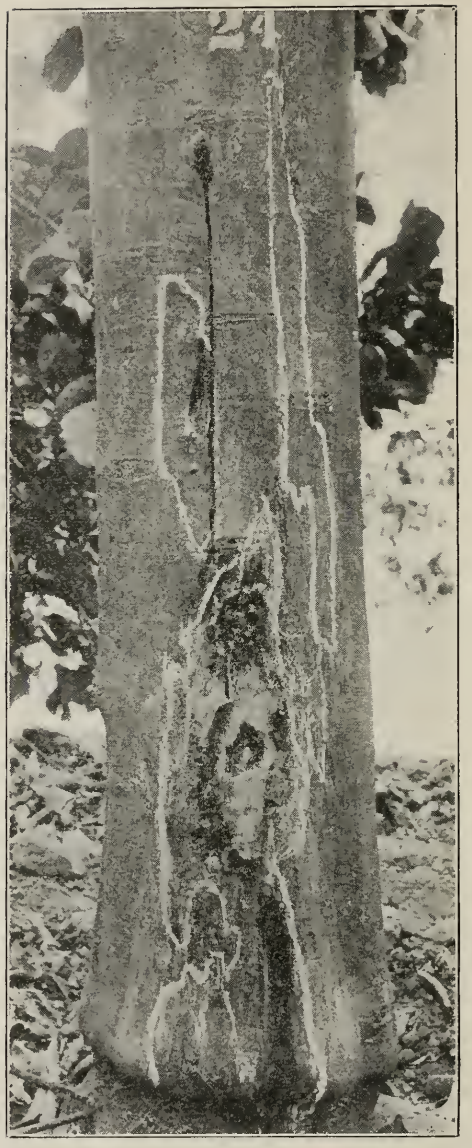

FIG. 348.—Lemon tree pounded with a hammer and infected with grey fungus (*Botrytis*) July 11, 1912. Photographed May 10, 1913, showing areas of diseased bark outlined with chalk marks. A pocket of gum near the top had formed under the live bark and is indicated by the dark line of exuding gum. (Original.)

Figure 348 shows a lemon trunk that had been injured by a blow from a crate hammer and then inoculated with spores of *Botrytis* and immediately waxed over. A spot on the opposite side of this tree was cleansed and pounded as on the side shown in Figure 348, and immediately waxed over without inoculation. This was done July 11, 1912. The hammer wound without fungus healed up without gumming. The inoculated wound shown in Figure 348 was gumming slightly August 22d, and copiously by September 24th. In the fall and winter it had stopped gumming, and the area of killed bark remained small until the spring of 1913, when it began to enlarge rapidly. The illustration (Figure 348), showing the area of killed outer bark outlined with chalk, was taken May 10, 1913, ten months after inoculation. A recent examination of this bark showed that the greater part of the inner bark and cambium was still alive under this killed area, and all but a few inches of it will probably be saved by the method of treatment described later, and illustrated by Figures 350 and 351. The application of pure neat's-foot oil to injuries or cuts in the bark that had been purposely infected with spores of the *Botrytis* fungus encouraged rather than hindered the growth and development of the fungus. Neat's-foot oil applied to sound pieces of bark placed in moist jars caused the *Botrytis* fungus to grow in two weeks five times as fast as on bark without the oil.

Brown Rot (Pythiacystis) Gummosis.

In September, 1913, a fungus was isolated from another type of gummosis at Whittier and inserted into the bark of trees at Santa Paula in November. This has produced a form of gummosis which is, in all respects, the same as that from which the fungus was isolated, and is probably the most common form of gummosis in California. The bark remains hard from the beginning, and is killed slowly all the way in to the wood, without there being the least evidence to the unaided eye or even through the hand lens of any fungus growth.

Figure 349 illustrates by the different lines of chalk marks the progress of the dying tissue from time to time. This tree was inoculated November 23, 1912. The smallest outlined area represents the killed area on February 12th, the next larger on March 14th, and the largest area on May 6, 1913. The bark was cut off at the time this was taken, May 6, 1913, to examine the condition underneath, and pure cultures of the brown rot fungus were obtained from this bark. It was found that in this case the killing of the inner bark lagged only a little behind that of the outer bark and the bark was hard over the entire area. These points appear to distinguish the brown rot (*Pythiacystis*) gummosis from that due to the grey fungus (*Botrytis*). Many other inoculations had been made with cultures from brown rot infected lemons and with bits of the infected lemons and typical cases of this form of gummosis have resulted in every case. Clean cuts not inoculated made in the opposite side of the same trees have healed up in the normal way without exception. Cultures isolated from diseased bark and put in contact with healthy lemons have produced brown rot, and cultures isolated from brown rot lemons and put into the bark have produced in every case this form of gummosis. Pure cultures of the brown rot fungus (*Pythiacystis citrophthora*) have been isolated from gummosis bark from as widely separated localities as Chula Vista, in San Diego County; Whittier, in Los Angeles County; Santa Paula, in Ventura County, and Lindsay, in Tulare County, and all these have, on being inoculated into healthy trees, produced the same form of gummosis. Cultures of the brown rot fungus have also been reisolated from the inner bark corresponding to the outer white line in Figure 349, and this has been done from several other trees that had been inoculated. These reisolated cultures have been placed again on lemon fruits and have given them brown rot. Neat's-foot oil applied to the surface of lemon bark and lemon fruits appeared neither to hinder nor to encourage the development and infection of the *Pythiacystis* or brown rot fungus mycelium that had been placed upon their surfaces.

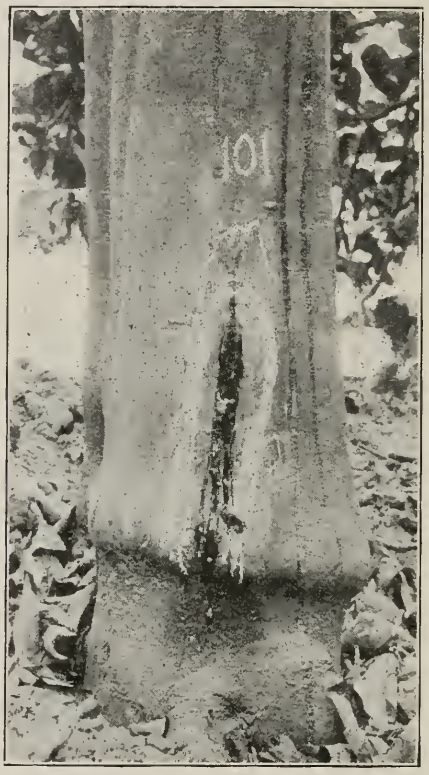

FIG. 349.—Lemon tree inoculated with pure culture of the Brown Rot fungus (*Pythiacystis*) November 23, 1912. Photographed May 6, 1913. The two narrow black lines to the right are due to tar, not gum, running down from a limb above. (Original.)

It is well known that the brown rot fungus lives in the soil, and that wet weather and abundant rains encourage its growth. This would seem to explain why flooding the trunk of the tree with water or allowing the bud union to get below the soil would produce conditions favorable to infection of the lemon tree trunk, and bring on this type of gummosis. The results of inoculations with the grey fungus, into the bark of lemon, sweet orange and sour orange trees, appear to show that the lemon is affected readily, the sweet orange much less readily, and the sour orange scarcely at all. This appears to furnish an explanation for the well known fact that sour orange trees are the least of all subject to gummosis under unfavorable orchard conditions, the sweet orange trees next and the lemon trees most of all. This may possibly be one explanation why lemons can not well be grown on their own roots in California.

Treatment of Gummosis.

Experiments discussed: Having found that two forms of lemon gummosis were infectious and that the causative agents were fungi, experiments were begun in co-operation with several of the lemon growers, not only to prevent the infection, but to find means of remedying those trees already infected. The requirements of a mixture to be used for this purpose seemed to us to be effectiveness in killing out the fungi, lasting qualities, inexpensiveness, and lack of injurious effect on the bark. The concentrated Bordeaux mixture was one of the most effective fungicides known, had lasting qualities that scarcely any other fungicide had, was inexpensive, and had been known to give good results when used for the treatment of similar troubles in Florida. Bordeaux mixture paste at various strengths, as well as a number of other fungicides, were tried out by the Limoneira Ranch. Bordeaux paste was also used by the San Diego Fruit Company at about the same time.* The experiments with the Bordeaux paste, which were begun over a year ago, appear to show that it is the most promising of any preparation yet tried. These investigations are yet in an experimental stage, and other growers may find something just as good. It seems certain, however, that the Bordeaux paste will prevent infection from these fungi when applied to bark not yet infected, and will kill out any of the fungus it is allowed to come in contact with, and will last a long time. So far the mixture has shown no injurious effect on the bark. It should be kept in mind that small patches of bark may be infected and have the fungus in them when there is yet no evidence of gum on the surface, and gum may exude after applying the mixture. Results from treatment of trees already diseased must not be expected too soon. The inoculation experiments before described show that the fungus may at times be in the bark for over a year before large areas are finally killed, and it will probably take as long, or longer, to work out all the infection.

Applying the Bordeaux paste: It seems from our present knowledge that the bark that is dead to the wood should be removed before applying the paste, in order to allow the mixture to kill out the infection. In grey fungus gummosis the outer bark is often infected and dead over large areas while the inner bark with cambium is still alive. In this case the outer dead part may be scraped off with a curved sharp tool made by a blacksmith on purpose for this work, leaving the inner part of the bark still attached (Figure 350). The idea of scraping the outer bark was conceived by Mr. J. D. Culbertson, and the instruments shown in Figures 350 and 351 were developed by him at the Limoneira Ranch.

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*Only recently the writer has learned of three or four other growers having used a similar mixture each independently of the knowledge of the other, two years or more, for gummosis and scaly bark with good results in all cases.

On trees treated on the Limoneira Ranch nearly a year ago by this method, the bark is healing well under the Bordeaux. The outer bark should be scraped an inch or so beyond the line of visible infection and the entire trunk painted with the paste (Figure 351). In the brown

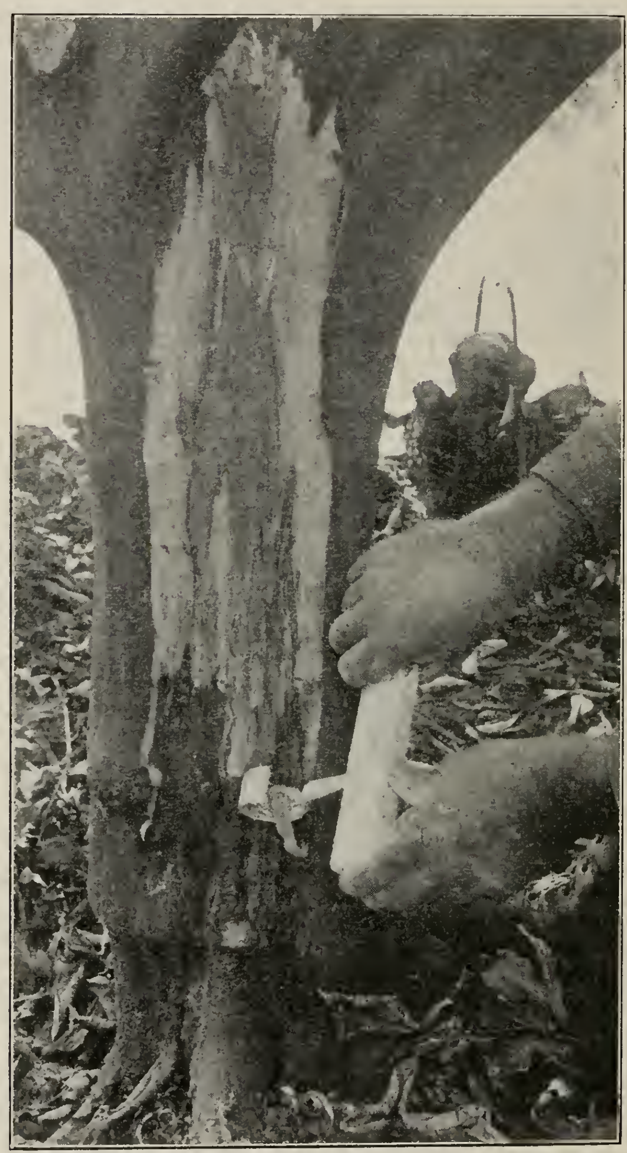

FIG. 350.—Tree affected with the *Botrytis* form of gummosis being scraped. (Original.)

rot gummosis, which is probably the most common and most widely distributed of the two on lemon trees in California, it will probably be well to cut out or trim out the bark an inch or so beyond the discolored line before applying the mixture. If this is done when the area of killed bark is small the infection may be stopped readily. Mr. J. A. Prizer of the San Diego Fruit Company has had good success with this method.

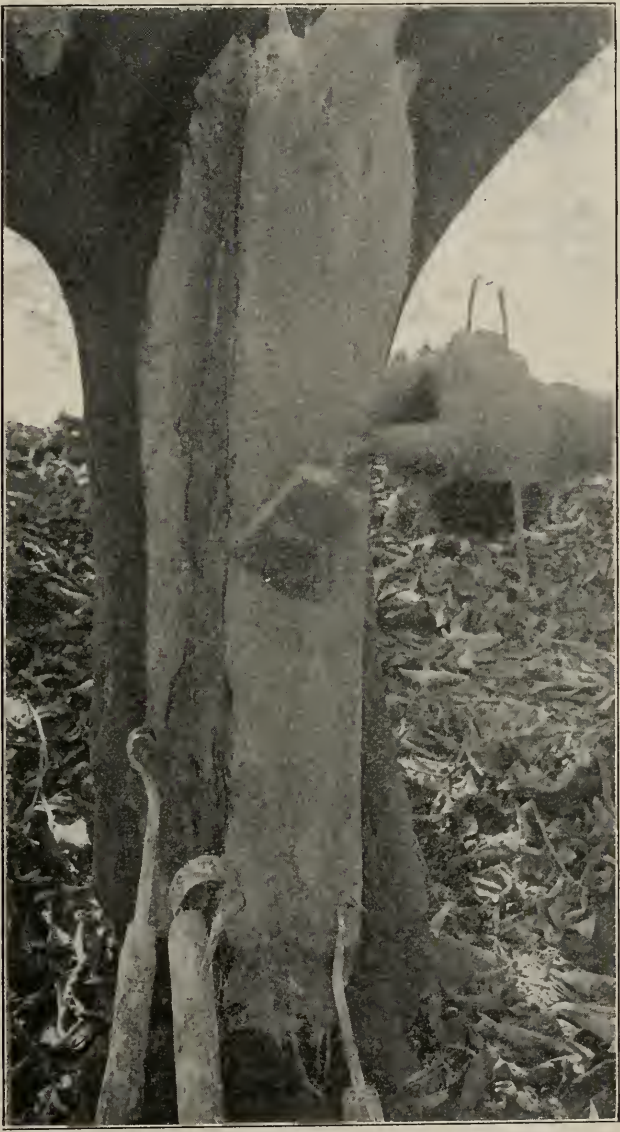

FIG. 351.—Lemon tree affected with gummosis, scraped and being painted with Bordeaux paste.

In trimming out this bark he uses a farrier's knife such as is used in trimming horses' hoofs. Where the killed areas of bark are so large that all the diseased bark can not well be taken off, two slits are made up the trunk, one on each side of the infection, for the purpose of confining it to one section of the trunk. Another cut is made to allow the gum to drain out. The entire surface is then covered with the Bordeaux paste. Just how much bark it is necessary to take out and whether slitting is necessary are questions that need to be further investigated. It seems advisable with our present knowledge to cut the branches back more or less severely on the side where the bark has been killed over a very large area. If the area is small, no cutting back need be done. If the bark is allowed to become entirely dead the greater part of the way around, it is then usually a waste of time to try to save it. One must expect the gum to run out freely for several weeks after treatment, even while healing is going on. One should watch for the formation of new healthy tissue rather than the amount of gum that is exuded after treatment. The gum that has already formed under the bark beyond where any fungus is found will drain out. The gum itself, as has been shown by inoculation, usually does not contain any infectious principle. The infectious principle (the fungus) is in the diseased bark or wood at the junction of the live and dead tissue. The formula that is being recommended as a result of a number of experiments by growers is as follows:

Bordeaux Paste.

> 1 pound of bluestone (copper sulphate) dissolved in 1 gallon of water in a wooden or earthen vessel. This can best be done by hanging it in a sack in the top of the water.
>
> 2 pounds of unslaked lime, slaked in about one half gallon of water. Some variation from these proportions may be made without greatly changing the value of the paste.

Stir together when cool, making a light blue mixture about the consistency of whitewash. If the mixture turns to some other color before being applied, it is an indication that something is wrong. Mix up fresh each day or two, as the mixed paste tends to deteriorate with age. It may be applied with a large brush as whitewash. (Figure 351). A wash made of equal parts of lime and sulphur (self boiled) is also being tried out. This may prove equally as good. Many other fungicides are being tried.

Summary.

Lemon gummosis in at least two forms has been found to be readily transmissible from diseased to healthy trees by inoculation.

By series of many inoculations into healthy trees it has been found that the grey fungus (*Botrytis vulgaris*) is capable of inducing one form of gummosis, and that the brown rot fungus (*Pythiacystis citrophthora*) is capable of inducing the other.

Both these fungi have been isolated from trees affected with gummosis, and after inducing gummosis in healthy trees have been reisolated from these inoculated trees. These fungi were found to be at the advancing margins of diseased areas in the bark and wood, and were not found in the exuded gum nor in the tissue already thoroughly permeated with gum.

The grey fungus (*Botrytis*) gummosis is characterized by a killing of the outer layer of bark much in advance of the inner, and by a softening of the bark and production of spores in moist weather, where the bark is entirely killed to the wood.

The brown rot (*Pythiacystis*) gummosis is characterized by a killing of the bark to the wood as the area of infection advances, without outward evidence of fungus at any time, the bark remaining hard during all stages of the disease.

The concentrated Bordeaux mixture or Bordeaux paste in about the proportion of 1 pound of bluestone, 2 pounds unslaked lime to about 1½ gallons of water has given promising results in the treatment of these two forms of gummosis, providing the diseased areas were properly prepared before its application.

SOME FIELD NOTES ON A SOFT GRAY SCALE KNOWN LOCALLY AS THE "LONGULUS" SCALE.

By DELACOURT KELL, County Horticultural Inspector, Pomona and Claremont district.

This scale is somewhat prevalent in my district, and hitherto has been very little affected by fumigation with hydrocyanic acid gas carried out at the time at which the best results can be looked for on the black scale.

The following notes, containing the experimental fumigation undertaken to determine at what season, if any, this scale could be killed, may therefore be of interest to those who have it in their groves and are fumigating this year. I believe Mr. R. S. Woglum is conducting some fumigation experiments for it on a larger scale, which should give us more reliable results, but meanwhile the following may be of some use.

Some of the notes are taken from my article in the Pomona College Journal of Entomology for November, 1912.

I believe the species of this scale has not yet been officially determined. It is known in my district as the "longulus" scale. It occurs also in other parts of this State.

This scale is somewhat similar to the soft brown scale (*Coccus hesperidum*) but is grayer, less shiny and the young are more transparent and lie flatter to the leaf, appearing to adhere closely to it as a mere film. The ants do not foster it to the same extent as they do *Coccus hesperidum.*

The scale is practically viviparous, though eggs can occasionally be found along with the live young under the old shells. The hatch appears to be fairly regular, extending from about May 1st to August 21st, in the two years I have had it under observation. Mr. Roy Campbell, who is working on the life history of this scale, tells me that he has counted as many as 500 young from one scale.

The adult scales vary much in size, giving the appearance of an uneven hatch, but one finds the quite small ones bringing forth young at the same time as those that are perhaps six times their size. The biggest are larger than the largest soft brown scale.

Soon after hatching begins the surface of the mother scales becomes dry and light brown in color, and begins to adhere less closely to the twig. At this stage they are found almost wholly on the smaller twigs, being arranged in places in an imbricated manner, covering the twig like fish-scales. When the young are all out, the dead shells are very apt to drop off, leaving whitish marks. One does not find many old shells of the preceding year, as is the case with the black scale.

This scale throws out a great deal of honeydew, the resulting smut making the trees very dirty, but this takes place somewhat later in the season than is the case with the black scale, so that the navel oranges have usually been picked; but the Valencias become much soiled.

With regard to the following experiments, in all cases the trees selected were the most badly infested that could be found of a suitable size. Sodium cyanide and the Woglum system were used.

As regards the condition of the scale when fumigated, young were still being produced under the old shells up to August 21st. On trees fumigated before that date apparently all the young under the shells at time of fumigation were killed, but the old mother-shells were not affected, so that a few young would be born after fumigation at any date prior to August 21st.

On or about July 1st, this year, I took a count, on each tree, of the adult scale that I could find in a ten-minutes' search. The number of adults that could be counted in the same time on a neighboring tree was also taken as a check and indication of the condition of the other trees in the same grove. But on the trees fumigated the number found in ten minutes would be about all the adults that were on the tree, whereas on the other trees this was by no means the case.

The results are not quite uniform, and the number of trees treated was not large, but I think the results may be held to indicate that there is a good chance of obtaining a fair killing on this scale between, say, July 20th and end of August. Between these dates there does not seem to be any marked difference in results. With regard to dosage, it seems to be that a three-quarters schedule would be advisable, to give a safe margin, while a heavier dosage than that does not seem to be justified.

With regard to the work of the contractors last fall, all the fumigations done after the middle of September were failures as far as the "longulus" is concerned. One grove fumigated on September 7th with an "estimated" schedule was also a bad failure, but in this case a very poor result was also obtained on the black scale. In one grove a very good result, both on the black and "longulus," was obtained on September 13th, but the same outfit got very poor results on "longulus" in another grove, close by, on September 17th, though they again got a good killing on the black. In both cases a five-eighths schedule was used. In another grove, where we got a very satisfactory result on "longulus" on September 4th on the six trees we fumigated, the contractor got a very poor result on it over the rest of the grove when it was fumigated only twelve days later, September 16th, using a five-eighths schedule, though he killed the black very well.

I may mention that all of the 57 trees fumigated experimentally are now fairly free from black scale as well as "longulus," though in some of these groves there is much black scale on the surrounding trees. This would go to show that the specially early fumigation necessary for the "longulus" may be looked for to also give a useful result on the black.

The experimental fumigation was done by Mr. C. H. Vary and myself in 1911, and by Mr. J. W. Mashmeyer, Mr. H. H. Schaper and myself in 1912, Mr. Schaper also supplying the outfit free of charge.

RESULTS OF EXPERIMENTAL FUMIGATION FOR "LONGULUS" SCALE.

Date	Grove	No. of trees	Schedule and number of minutes; number of scale counted in 10 minutes on July 1, 1913							Check tree, fumigated by contractor.		
			1/2 twice 30 & 45	1/1 60	3/4 60	3/4 45	5/8 45	1/2 45	1/2 30	Date	Schedule	Scale counted, July 1, 1913
1911.												
Aug. 28	I	1	-------	23	-------	-------	-------	-------	-------	12/16/11	1/1	520
Oct. 9	I	4	10 12	------- -------	------- -------	4 -------	------- -------	14 -------	------- -------			
1912.												
July 23	III	5	-------	-------	-------	10	16 22	14 26	------- -------	12/6/11	1/1 & 1 1/2	500
July 25	IV	5	0 0 1	------- -------	3 -------	0 -------	------- -------	------- -------	------- -------	1/25/12	7/8	156
July 27	V	6	2 1	-------	3	2	0	18	-------	12/8/11	1/1	300
Aug. 12	VI	6	22 7	-------	33	33	36	43	-------	11/2/11	1/1	230
Aug. 13	VII	6	3	0	-------	1	8	2	4	10/17/11	1/1	143
Aug. 14	VIII	6	6	6	-------	5	11	44	4	11/17/11	1/1	900
Sept. 2	IX	6	36	1	-------	1	11	8	11	11/19/12	5/8	320
Sept. 3	I	6	3	2	-------	10	12	25	90	12/16/11 12/10/12	1/1 ?	1000
Sept. 4	II	6	0	1	-------	0	1	6	10	9/16/12	5/8	470
Average counts		57	6.75	2	13	7	13	21	24			

A BILLBUG INJURIOUS TO SMALL GRAIN.

(*Sphenophorus discolor* Mann.)

Order—Coleoptera. Family—Calandridæ.

By Harry S. Smith, Superintendent, State Insectary, Sacramento, Cal.

Species of the genus *Sphenophorus* are frequently found to be serious pests in some parts of the United States, but in California they rarely attract attention. These insects, more commonly known as "billbugs," at times cause a very considerable injury to corn and sugar cane, but their attack on small grains is of much less common occurrence. For these reasons the following observations on *Sphenophorus discolor* Mann.* are deemed worthy of recording.

Attention was called to the injury of small grain by this *Sphenophorous* on May 22d by Mr. Eichoff, Assistant Agriculturist of the West Sacramento Company. Specimens of the beetle were brought to the Insectary. Mr. Eichoff was accompanied to the experimental plats where some grains were being grown, and the beetle was found to be doing a considerable amount of damage to all varieties of barley, wheat and oats. The injury was particularly conspicuous, as the heads of all plants affected had turned white and the kernels had failed to develop. On examination it was found that the beetles inserted their

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*Determined by Dr. E. A. Schwarz, Bureau of Entomology, through the kindness of Mr. W. D. Pierce.

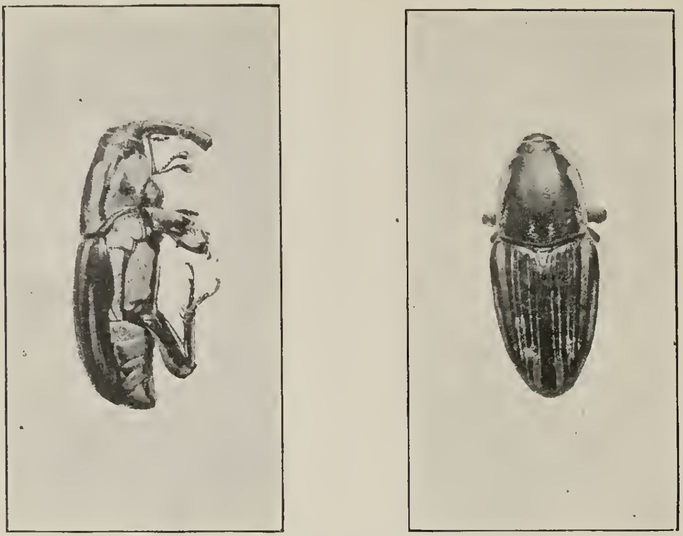

Fig. 352.—*Sphenophorus discolor* Mann., enlarged about one and one-half times. (Photo by Essig.)

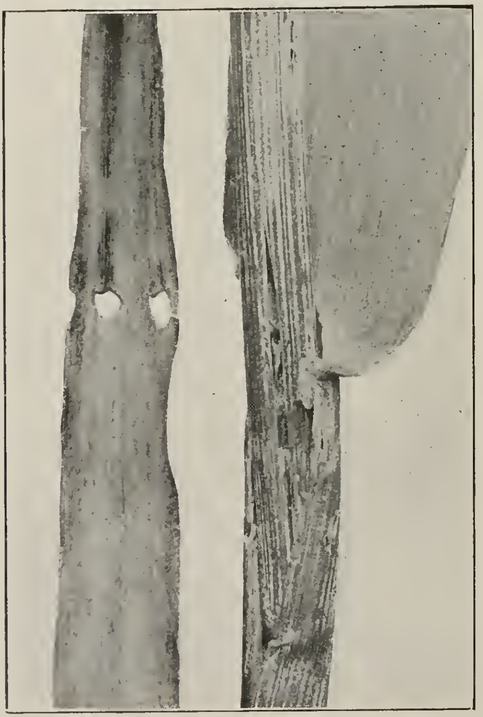

Fig. 353.—Barley stem showing slit made by proboscis of *Sphenophorus discolor* Mann., also leaf showing punctures. (Photo by Essig.)

probosces through that part of the stem known as the boot. The main stalk bearing the head was then entirely severed, this of course ruining the plant for all but forage purposes. The beetle was found commonly at work in the fields, clinging to the stalk of grain, usually with the head downward.

The surrounding country is mostly covered with a heavy growth of the common tule or bull rush (*Spirpus lacustris*), and the ground upon which affected grain was growing was but recently reclaimed from this sort of land. There seems to be but little doubt that the billbug breeds in the roots of these tules. Their great size would preclude their breeding in many of the smaller grasses in which the *Sphenophorus* develop. However, no larvæ or pupæ were discovered. It is probable that this insect will prove to be injurious only during the first year that grain is grown on tule land. The destruction of the rushes would leave no breeding place, and in consequence the billbugs would disappear in a short time.

THE CODLING MOTH.

(*Carpocapsa pomonella* Linn.)

Order—Lepidoptera. Family—Tortricidæ.

By Geo. P. Weldon, Chief Deputy Commissioner of Horticulture, Sacramento, Cal.

Wormy apples and pears are of more common occurrence this season than usual in sections of the State where pome fruits are grown. Probably the codling moth is no more abundant than it is other seasons, but there is such a small crop of fruit in a majority of the orchards that a much higher percentage of it is wormy.

During seasons of light crops the codling moth is generally very difficult to control, simply because there are just as many of the moths to start with and only a relatively small number of apples or pears for their progeny to feed upon. If there are several larvæ trying to feed upon the same apple, the chances are that one or more of them will be successful in entering at a point unprotected by spray. The large number of these fruits, wormy in the calyx end, indicates that the calyx application, the most important of all in controlling codling moth, was not made thoroughly or not at the proper time. This application must be made before the calyx cups close, which will be scarcely more than a week after the petals fall in the case of apples and a much longer time with pears. Indeed, some varieties of the latter never close the calyx entirely, and there would seem to be no excuse for not protecting the fruit from the entrance of worms at that point. A carefully sprayed orchard, if the spraying were done at the proper time to protect the calyx, should have practically no fruit wormy in the blossom end. Arsenate of lead, or any other good arsenical spray placed in the calyx, will, in the case of the apple at least, remain there and kill practically all worms which try to enter that way throughout the entire season.

THE MANZANITA SERICA.

(*Serica anthracina* Lec.)

Order—Coleoptera. Family—Scarabæidæ.

By E. O. Essig, Secretary State Commission of Horticulture, Sacramento, Cal.

In the latter part of April this office received a communication from Mr. J. E. Hassler, County Horticultural Commissioner of El Dorado County, stating that a certain fruit orchard in the foothills near Placerville was being defoliated by a mysterious foe, the presence of which could neither be found nor accounted for. He also stated that two years ago the attention of this office was called to this condition, and that the secretary of the Commission spent a day in the orchard, but was unable to locate the trouble. At the request of Mr. Hassler the writer went to Placerville with the idea of ascertaining, if possible, the depredator, and to suggest means of control. On May 20th Mr. Hassler took the writer to the orchard, and the damage to the trees, especially prune and apple, proved serious. Practically all of the leaves were removed to the stem. This work had continued for over a month, and some of the trees had been killed during the past year because of the constant and complete defoliation.

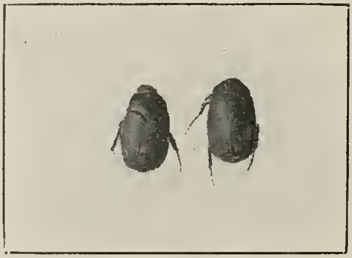

FIG. 354.—Adult specimen of the manzanita serica, *Serica anthracina* Lec. Natural size. (Original.)

At first sight the work appeared to the writer to be that of the scarabæid beetles, and after two or three hours of diligent search a single specimen was found actually eating the leaves of a prune tree. This was followed up, and before we left we were able to find a dozen actually doing the work; so that we had discovered, beyond doubt, the pest.

Inasmuch as the principal damage was done to trees around the edges of the orchard, the writer was led to believe that the beetle found was of native origin and would probably occur on the wild shrubbery adjoining the orchard. This supposition was confirmed immediately by finding the same beetle abundant on the manzanita and producing exactly the same injury to this shrub as to the orchard trees. Great numbers were found feeding upon this plant around the entire orchard. It was also found feeding in less numbers upon the black oak, lupines and upon *Ceanothus* sp.

The least touch to the host plant would cause the beetles to drop immediately to the ground and secrete themselves under any hiding place. Even if the beetles saw one approaching they would drop to the ground. This probably accounts for their not being discovered sooner. The beetle, Figure 354, varies from a light brown to almost black in color and is less than half an inch in length.

Apparently this insect is most abundant in the foothill section of the Sierra Nevada mountains, having been reported about Bowman, Placer County, California; Nevada City, Nevada County, California; Placerville, El Dorado County, California, and Inyo County, California, but it has also been reported to occur in Fresno County, where it attacks the foliage of the plum. It is probable that this insect was driven to the orchard trees due to the shortage of green wild shrubs because of the dry year, and that it will never be a serious pest except under these conditions.

The best remedy is the application of a lead arsenate spray prepared as follows: 8 pounds lead arsenate, 8 pounds lime to 100 gallons of water. The lime acts somewhat as a repellant. This spray should be applied as soon as the beetles appear in the spring, and the tender tips and twigs drenched liberally. Repeated applications will be necessary to thoroughly protect the trees.

The writer is indebted to Mr. Charles Fuchs, of the California Academy of Sciences, for the identification of this insect.

GENERAL NOTES.

THE PRUNE APHIS.

(*Aphis prunifoliæ* Fitch.)

The appearance of this aphid was recorded on page 569, volume II of The Monthly Bulletin in June, 1913. Since this record the aphid has been reported from many prune-growing sections of the Sacramento Valley and has caused alarm and worry to some of the orchardists. The louse is light green in color, and is covered with a rather thick coating of fine white powder, which at once distinguishes it from all other lice attacking the prune. It attacks the tips of the twigs and collects in exceedingly large colonies, especially upon the under sides of leaves which are slightly curled by their work. Figure 355 shows the actual conditions on a single prune leaf taken from the Yolo orchard in Yolo County on May 10, 1913. At that time the presence of the larvæ of syrphid flies and internal hymenopterous parasites were in sufficient numbers to indicate that the pest would be subdued before it did any great amount of damage. In a few sections, however, control measures were found necessary, which consisted of the application of a tobacco spray composed of nicotine sulphate in the proportions of 1 to 1500. A coarse driven spray under high pressure is necessary to force the liquid through the powdery waxy coating secreted by the insect.—E. O. Essig.

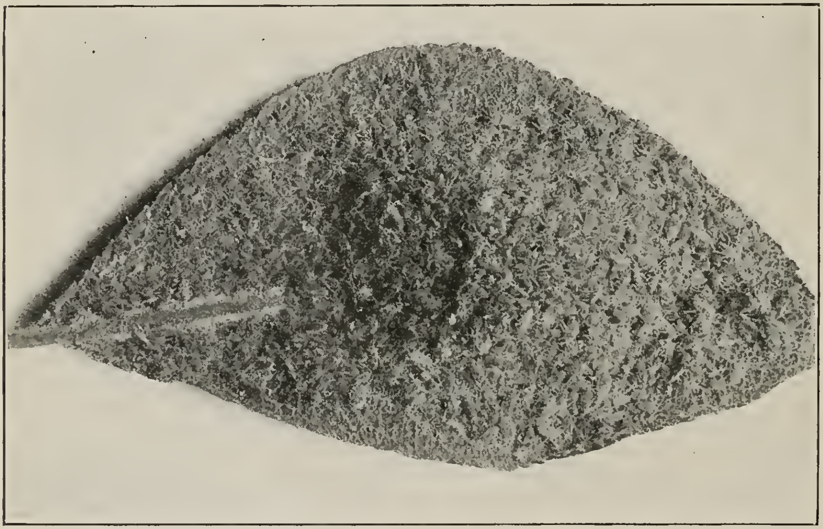

Fig. 355.—Prune leaf covered with the prune aphis, *Aphis prunifoliæ* Fitch. Slightly enlarged. (Original.)

HORTICULTURAL PRODUCTS FROM JAPAN.

Working under a well defined policy of permanent progress in every phase of the service, and with particular reference to horticultural material intended for exhibition at the Panama-Pacific International Exposition, the executive head of the quarantine division at San Francisco and the Japanese Consulate at that port have been co-operating for some time in an effort to improve the condition of trees and plants imported into California and the United States in general from the nurseries of Japan. The equity of each phase of the situation has been thoroughly discussed, and articles dealing with the practical methods employed in California to keep nursery stock clean of insect pests and in which the salient points that make for success in fumigation were clearly portrayed and strongly emphasized, have been prepared and furnished to the Consulate. These translated into Japanese were forwarded to the officials in Japan, together with specimens *in situ* of thirty different insect pests taken from material found on imports from that country by the quarantine inspectors at San Francisco during the past season.

The quarantine office at San Francisco is in receipt of information from the Consulate that in conformity with the regulations of the Plant Quarantine Act the Government of Japan has established a quarantine service for the inspection and control of plants intended for exportation, with officers and stations at Tokyo, Yokohama and Kobe. This is decided progress, and its results will eventually be far reaching.—FREDERICK MASKEW.

BLACK TREE PROTECTORS TO PREVENT RODENT INJURY SHOULD NOT BE USED.

Often it becomes necessary to protect the trunks of young trees in some way or other to keep rabbits and other rodents from barking them. For this purpose various kinds of shields have been used with success.

The writer recently examined some two-year-old olive trees in an orchard near Madera, where heavy, black paper shields were being used in this work. It was claimed at the time that they were put on, which was during the previous season, that the fact that they were black would not make them liable to damage the trees, this tendency having been overcome by perforations in the paper. While this might be a good selling point for these shields, in actual tests it did not prove sufficient to prevent severe sun-scald on the south side of trees. My visit to the orchard had been preceded by several days of very hot weather; many trees had recently died and many more were scalded on the south side of the trunks. Every tree examined showed more or less of this injury, even though the tops appeared perfectly normal.

While the use of protectors is good both in keeping off rodents and preventing sun-scald in some cases, a black protector should not be used during the hot season at least. Light colored wooden or paper protectors will serve the purpose for which they are intended just as well and will not endanger the lives of the trees from scald during the hot weather.—GEO. P. WELDON.

WHAT OF INTRODUCED PARASITES?

The passage of Dr. F. Silvestri through San Francisco on June 19, 1913, with a splendid collection of living specimens of several species of fruit fly parasites, awakened a new interest in the possibilities of this rational method of controlling imported insect pests, and brought forcibly to the mind of the writer the many shipments of similar live active collaborators sent by him to California in years past, and at the same time a vivid remembrance of the manner in which the same were treated after arrival.

In view of the publicity given to Dr. Silvestri's well earned success and as an incentive to further work along these lines, the following suggestions are offered. That an investigation be made of the causes—

Why the grasshoppers have never been epidemic in the Livermore Valley since the fifty-nine living specimens of locust parasites were liberated in that locality by the late Alexander Craw on June 11, 1900, the same having been sent to him by the writer from New South Wales, Australia?

Why no more complaints are heard from the Fresno County grape growers about the mealy bug pest since the writer liberated the small Philippine ladybugs in the vineyard of the Backer Vineyard Company three years ago?

What has become of the Pulvinaria pest in the apple orchards at and around Downey in Los Angeles County since Frederick Maskew liberated the Hymenopterous parasites in those same orchards which had been obtained from one of the eastern states?—GEO. COMPERE.

INSECTARY SUPERINTENDENT TO COLLECT IN ORIENT.

Mr. Harry S. Smith sailed on the 5th of August for the Orient, where he goes to seek valuable beneficial insects. Owing to lack of funds, no other will engage in the service this year. Some time since, Mr. Smith discovered in Europe some seven parasites or predaceous insects on the alfalfa beetle, which he transported and introduced in the alfalfa fields of Utah. We have great reason to hope for rich results in this present undertaking. He will be absent two or three months.—A. J. COOK.

LADYBIRD BEETLES SENT OUT.

The State Insectary has collected and distributed 75,000,000 of the ladybird beetles *Hippodamia convergens* this year, as against 43,000,000 last year.—A. J. COOK.

THE DESTRUCTIVE ELEODES.

(*Eleodes omissa* var. *borealis* Blaisd.)

During the month of May, Mr. K. S. Knowlton, County Horticultural Commissioner of Kern County, sent specimens of a tenebrionid beetle, which he reported as doing much damage to orange trees around Bakersfield. Later he also sent specimens to the writer. On June 9, 1913, Mr. E. F. Siegfried of Wasco, Kern County, wrote that a black beetle had stripped quite a number of apricots and plum trees in his orchard. He reported that they were so thick as to entirely cover the ground.

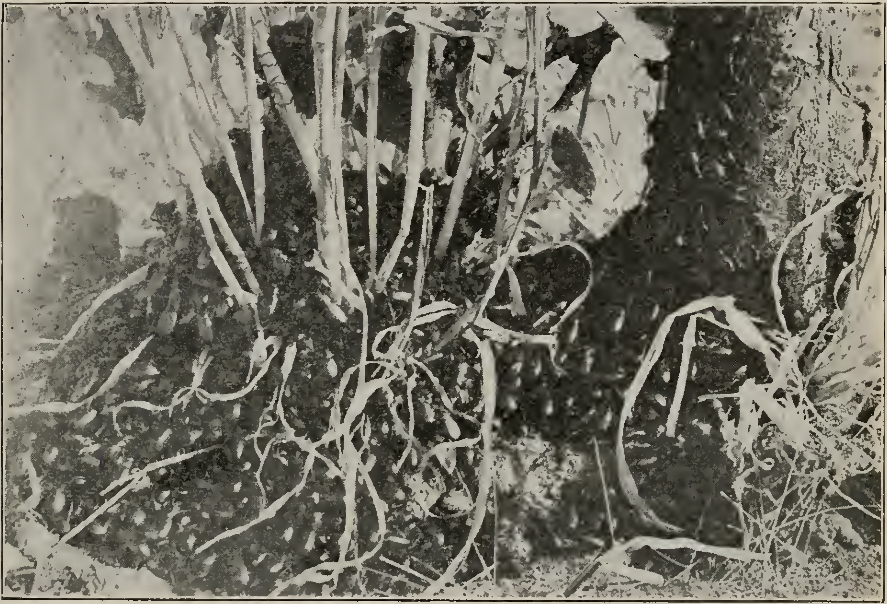

Fig. 356.—The destructive eleodes, *Eleodes omissa* var. *borealis* Blaisd. Collected at the base of an apricot tree. (Photo by E. F. Siegfried.)

Figure 356 was taken by Mr. Siegfried, and shows the beetle at the base of an apricot tree. Watermelon vines are also severely injured by this beetle.

Poison bran did not seem to offer a ready means of control, inasmuch as the insects preferred plant food. Poison sprays strongly applied are not as effective against this beetle as against some other insects, due to its highly resistive powers.

Its occurrence in such numbers is probably due to the dry season, which was apparently very favorable to breeding.—E. O. Essig.

MONTHLY CROP REPORT—JULY.

These data are compiled by the secretary from monthly crop reports made by the county horticultural commissioners. Counties not included have not reported or the reports have come too late for press. Unless otherwise designated, percentages refer to last year's crop.

The crop report of this month has been materially changed throughout the State due to the excessive dry weather and hot winds which have prevailed. Some sections were not injured as much as others, but there is hardly a location which has not suffered. These conditions, together with the late frosts, will make a considerable shortage in a number of crops.

Alfalfa.

The reports relative to the alfalfa crop are very encouraging, and with the exception of a single locality the crop will average from 90 to 100 per cent of that of last year. In most localities there will be as much alfalfa produced as was produced last year.

Almonds.

The almond crop is exceedingly spotted throughout the State. While some counties, notably Alameda, Madera and Riverside, report a slight decrease over the report of last month, other counties, including Butte and Monterey, report a slight increase. In only a few localities will there be a full crop, while in others the range varies from 10 to 90 per cent, the average being from 50 to 85 per cent. The excessively dry weather is responsible for a slight reduction over last month's estimate in the localities noted.

Apples.

The apple crop will be decidedly short, due, as in the case of many other fruits, to the dry weather. There are no reports of an increase over that of last month, with the exception of a slight increase in some of the northern counties. The largest producing sections, including Monterey, Santa Cruz, Lake, Mendocino, El Dorado and Nevada, will produce less than half a crop, the average being from 25 to 30 per cent. Sonoma County reports a crop of 85 per cent of last year, which may be slightly decreased because of the dry weather. Humboldt reports 90 per cent of last year's crop, which was only 65 per cent of normal. Santa Cruz—20 per cent of last year's crop.

Apricots.

The conditions of the apricot crop over last month's report have changed only slightly, there being a slight increase in most localities. Throughout the State the crop was short, varying from 35 to 100 per cent of normal crop.

Beans.

The bean crop will be good throughout the State, varying from 70 to 100 per cent of full crop.

Beets (Sugar).

The sugar beet crop will be a little short, due to the dry weather. Only incomplete estimates have been made.

Berries.

Reports still show that there will be a good crop of berries throughout the State. The lack of moisture is especially reducing the strawberry crop.

Cherries.

Reports of the cherry crop have not materially changed from those of last month. Dry weather caused considerable of a reduction in the valley sections.

Grapes.

The grape crop in the Sacramento and San Joaquin valleys will be much shorter than was predicted, due to the hot, dry weather, which caused considerable sunburn. The burning was largely due to the defoliation of the vines by injurious insects, including grasshoppers in the central part and vine hoppers in the San Joaquin Valley. In many localities the crop will run as low as 50 per cent. The wine grapes will produce a better crop than either the raisin or table varieties.

(Raisin).

The raisin crop in Fresno County will be 70 per cent of normal. Kings County reports 90 per cent due to heat. Madera will have only 70 per cent, due to hot weather and vine-leaf hoppers. The water table in that county is seven feet lower than usual. All varieties in Orange County report a good crop. Solano County will have only 40 per cent of a crop because of sunburn. Yolo County reports a very short crop, ranging from 10 to 25 per cent, due to hot weather, which produced sunburn. Yuba County reports 70 per cent, due to similar weather conditions.

(Table).

Table grapes were seriously injured because of the hot weather, and in all sections the crop will be short, averaging from 75 to 90 per cent. San Joaquin—Pretty well cooked, especially where not irrigated. Tokays suffered most; some damaged 60 per cent.

Wine.

Wine grapes promise a fair crop, being reported from the various counties as follows: *Alameda*—70 per cent. *Butte*—100 per cent. *Fresno*—100 per cent. *Kings*—90 per cent. *Lake*—100 per cent. *Los Angeles*—100 per cent. *Madera*—85 per cent. *Napa*—80 per cent. *Orange*—150 per cent. *Riverside*—90 per cent. *Sacramento*—50 per cent. Sunburn and dry, hot winds are responsible for this shortage. *San Bernardino*—95 per cent. *Solano*—90 per cent. Regarding the crop in Sonoma, Mr. Gallaway writes: "Some varieties of grapes also were quite badly burned in places, but in spite of the excessive heat and grasshoppers, I am of the opinion that there will be more grapes produced in Sonoma County this year than last." In Santa Clara the former reports remain the same. In Yuba County and other sections of the Sacramento Valley the crop will average about 70 per cent, due to the hot winds.

Hay (Grain).

Only a few counties have reported relative to the conditions of this crop. The counties along the coast and in the interior and southern parts of this State will have from 50 to 70 per cent of a crop, while the foothill counties and the mountainous counties will have a good crop.

Hops.

The hop crop promises to be very good in spite of the hot weather. The following producing counties have reported: *Lake*—full crop. *Mendocino*—full crop. *Sacramento*—full crop. *Sonoma*—good crop. Mr. Gallaway writes that the growers seem to have been benefited in a way by the hot weather, as the hop lice, which were threatening their crop, have been almost eradicated. Yuba will produce but 60 per cent of a crop. Other localities have not reported.

Lemons.

The situation relative to the lemon crop has not greatly changed throughout the State. Butte County reports 15 per cent decrease under report of last month, while Orange County reports an increase of 10 per cent. Los Angeles County will have 15 per cent of normal crop instead of 10 per cent, as previously reported. In other sections the reports of last month still hold good.

Olives.

According to all reports, the olive crop will be much larger than that of last year. Butte County reports twice as much as last month. *Fresno*—50 per cent more. *Los Angeles*—5 per cent more. *Madera*—100 per cent more. *Sacramento*—5 per cent more. A few counties report a slight decrease under last month's estimates. Nearly all of the other localities report a full crop.

Oranges.

The condition of the orange crop in the south remains practically the same as first reported, with an increase of 40 per cent in Los Angeles County, and from 5 to 20 per cent in Orange County, which reports navels 100 per cent and valencias 75 per cent. Santa Barbara County reports navels 100 per cent of last year's crop. Butte County reports a decrease of 15 per cent, and Sacramento County a decrease of 5 per cent under last month. Mr. G. Harold Powell predicts a 65 per cent to 80 per cent crop of citrus fruits this year.

Peaches.

Reports concerning the peach crop are more favorable this month than last, there being a considerable increase. Alameda reports 25 per cent increase, and Orange a large increase, especially in drying varieties. The crop throughout the State ranges from 25 to 100 per cent, the average being about 75 per cent. *San Joaquin*—Muirs 80 per cent, Lovells 75 per cent, Elbertas 50 per cent.

Pears.

The reports relative to pear crop show a slight increase over that of last month. In the Sacramento Valley there has been a slight decrease due to the dry season. The range in the production compared with last year is from 25 to 100 per cent, the average being about 75 per cent. *San Joaquin*—a good crop, but in many instances undersized. *Tehama*—from 20 to 50 per cent of last year's crop.

Plums and Prunes.

There is a marked falling off in regard to the yield of these crops, a notable decrease being reported in nearly every locality. The crop ranges from 25 to 75 per cent, or an average of about 50 per cent. Hot winds injured the crop in Sonoma and Yolo counties, so that the former will be less than 10 to 15 per cent of last month's report. The crop in Yolo will be from 15 to 25 per cent. *Contra Costa*—50 per cent. *Tehama*—40 per cent. *Santa Clara*—Mr. Morris reports: "The prune orchards are showing the effects of the hot dry weather. Some fruit can not ripen properly, and some is dropping. The estimate must be lowered, but how much it is impossible for me to say with the slightest degree of accuracy."

Walnuts.

There is a slight increase in the estimate regarding the walnut crop, the southern counties reporting good yields. Orange County reports all varieties heavier loaded than last year, with a reduction of 5 per cent by blight. Santa Barbara reports 198 per cent of last year's crop. Contra Costa reports a crop of 20 per cent more than last year, which was but 60 per cent of normal.

Cotton.

Mr. Wilsie reports 25,000 acres of cotton in Imperial County looking good, with excellent prospects.

Cantaloupes.

The season is just over for the marketing of 6,100 acres of cantaloupes, which has been successful; the growers will realize about $150 per acre. The facts are not all in to make exact accounting.—W. E. Wilsie.

INSECT NOTES.

The rosy apple aphis, *Aphis sorbi* Kalt. This pest is found to be quite common, though serious only occasionally, this season. There is probably no other aphis that attacks the apple that can do as much mischief as this one. In places it is being kept in check quite well by natural enemies; in still others they are not sufficiently numerous to control it. This aphis not only affects the foliage, but the fruit as well, and in certain orchards visited much fruit has been seen that is ill-shapen, has made no growth and can not possibly mature. The leaves are rolled very tightly by this pest, and a spray for its control should be applied early in the season when its first appearance is noted. The tobacco preparation, known as Black Leaf "40," is one of the very best sprays to use in controlling it. About 1 part of the Black Leaf "40" to 800 to 900 parts of water and a little soap to make it spread and penetrate better is sufficient to kill.

The Oregon Experiment Station recommends a mixed spray of lime-sulphur and Black Leaf "40."—GEO. P. WELDON.

The peach twig-borer, *Anarsia lineatella* Zell. As early as July 4th at Hanford, Kings County, signs of the twig-borer constructing their little cells or hibernaculæ in the crotches of small peach trees were noticed. On July 16th at Hollister, San Benito County, many freshly made mounds of borings were seen in the crotches of peach trees in that section. Some of the hibernating cells were cut into and the larvæ found within. Again on July 18th at Hayward, Alameda County, a number of larvæ were found in hibernating cells in small crotches of apricot trees. The apricots in a fair-sized orchard showed considerable infestation, and it will probably be necessary to spray for its control another season. A spray of lime and sulphur, 1 part to 9 of water, if applied thoroughly during the dormant season will give almost perfect results.—GEO. P. WELDON.

The cherry slug, *Caliroa cerasi* Linn. The foliage of pear trees is being attacked by this pest in various parts of the State where this fruit is grown. An orchard in Alameda County, which was inspected on July 18th, was found to contain a great many eggs. The tree had been sprayed recently with Paris green and lime in order to control the codling moth. The spray answered a double purpose, for practically all of the cherry slugs were killed also. The eggs hatched well, and the spray could be seen on the leaves where the little larvæ had fed for a short time prior to getting a fatal dose of the poison. This pest is one of the easiest to control by means of an arsenical spray, and there is little excuse for the damage that we often see from its attack.—GEO. P. WELDON.

The mealy plum aphis, *Hyalopterus arundinis* Fab. This species of aphis is commonly found at this time on plum, prune and apricot trees. Ladybird beetles and other enemies are controlling it quite well in most cases. Its damage is probably over for the season. Another season should it become bad a nictotine spray should be used.—GEO. P. WELDON.

Jumping oak galls. A. G. Shulz, Horticultural Commissioner of Tulare County, has sent galls from oak trees which look like small eggs and are surprisingly active. They hop about in a most lively fashion. The cause is the larvæ of a cynipid gall fly, which are within the galls.—A. J. COOK.

A small blue and bronze chrysomelid beetle, *Colaspidea varicolor* Cr., has done some damage to the foliage of young prune and pear trees in Nevada County. It works upon *Ceanathus* sp. in the mountains, having also been collected in Placer and El Dorado counties.—E. O. ESSIG.

Bruchus pruininus Horn has been collected feeding upon rose bushes on the Capitol Park.—E. O. ESSIG.

The harlequin cabbage bug, *Murgantiaa histronica* Hahn, is very common on cabbage at Chicago Park, Nevada County, Cal., this summer.—E. O. ESSIG.

The elm-leaf aphis, *Schizoneura rileyi* Thos. (*S. ulmi* Riley) has recently been reported by S. H. Essig as occurring on the American elm at Ventura, California. This appears to be the first report of this insect in this State.—E. O. ESSIG.

NOTES FROM THE COUNTY COMMISSIONERS.

Alameda County.

Commissioner Fred Seulberger is advising the control of the pear and cherry slug, which is doing much damage to the orchards of his county.

Butte County.

Black scale is showing up in considerable numbers in the olive orchards of Butte County, and control arrangements are being made by Commissioner Earl Mills.

Imperial County.

The date for the examination for county horticultural commissioner is August 14, 1913.

Inyo County.

Mr. Richard Baird has tendered his resignation as county horticultural commissioner.

Madera County.

Commissioner George Marchbank and Mr. Geo. P. Weldon have recently made an orchard inspection of the eastern part of the county.

Mendocino County.

Examination for county horticultural commissioner will be held at Ukiah, August 19, 1913.

Nevada County.

Commissioner D. F. Norton has been using a spray composed of 10 pounds arsenate of lead, 10 pounds lime and 100 gallons of water as a means of preventing grasshopper attacks on young orchard trees. The lime appears to have some value as a repellent.

San Bernardino County.

Because of dry weather, Commissioner S. A. Pease reports unusual abundance of Russian thistle, powdery mildew of the apple, woolly aphis, codling moth, citrus red spider and walnut aphis.

San Luis Obispo County.

This county is still without a horticultural commissioner. The names of 36 signers to a petition were handed in, but supervisors would not act. The growers mean business and will send in another petition, hoping to meet all objections.

Santa Barbara County.

Commissioners C. W. Beers and Mr. H. S. Fawcett are conducting some studies relative to black sap of walnuts, which has appeared somewhat serious this year.

Work is also being conducted by the University of California to devise the control of certain beetles and fungi attacking live oaks of Montecito.

The U. S. Department of Agriculture is experimenting with the carob tree at Santa Barbara, and present indications point to the commercializing of this plant as a new forage crop.

Santa Clara County.

Commissioner Earle Morris is recommendingg a spray of 2½ pounds arsenate of lead to 50 gallons of water for the second brood of the California oak moth. He advises applications while the caterpillars are small.

Sonoma County.

Commissioner Gallaway has been using poison bran successfully in combating grasshoppers in the vineyards of his county.

The grapevine beetle and hop aphis have ceased serious work and will probably do little damage this year.

Tulare County.

Commissioner A. G. Schulz has had wonderful success in keeping the orchards of his county free from serious citrus pests.

Ventura County.

Commissioner Vaile announces marked beneficial results in the control of walnut aphis by lime-sulphur spray applied in the spring, just as the buds are starting. The work was conducted by the State University.

Yolo County.

Commissioner Geo. H. Hecke has charge of his county's exhibit to be made at The Panama-Pacific International Exposition in 1915. In addition to this, he is actively engaged in making the county fair to be held August 22–25 a success.

QUARANTINE DIVISION.

By Frederick Maskew, Chief Deputy Quarantine Officer, San Francisco, Cal.

The following extract from the report of the United States grand jury at San Francisco is herewith published by and with the consent of that body:

"**Mediterranean Fruit Fly.**"

The attention of the jury has been directed to this matter, and it has been given very serious consideration and careful investigation. The quarantine officials, both State and Federal, have been examined, together with exhibits and specimens—many witnesses, including steamship officials and ship officers having been examined at length.

The seriousness of the introduction of this pest into the State of California does not appear to have been fully realized by the crews manning the vessels coming from Hawaii and other points where this fly exists, and we find a dangerous lack of knowledge on the part of the public generally. The seriousness and gravity of the present situation can not be overestimated. The ravages of this fly have ruined the fruit industry of Australia, and in less than three years it has devastated the fruits and vegetables of the Hawaiian Islands. It is generally conceded that should this fly obtain a foothold in the State of California, it means the ruin of the entire fruit industry, including many vegetables, of this great State. Hundreds of millions of valuable property are directly menaced and endangered. If the fly once finds a lodgment at any point in the State, the world will immediately quarantine against the entire State of California. This will mean that not one pound of fresh fruit can be shipped out for consumption elsewhere. Its damaging effect also upon the dry and canned fruit industry would be enormous.

Through the activities of this grand jury the importance of this matter has been forcibly brought home to the steamship companies and crews manning the boats. Some good has undoubtedly been accomplished, but we feel that we must direct the attention of all officials, State and Federal quarantine officers, the district attorney and the future grand jurors to the terrible consequences should the Mediterranean fruit fly obtain entrance to this State through the laxity on the part of any one charged with the duty of protection in this regard.

We find the present force of quarantine inspectors active, energetic, and alive to their responsibilities. We urge that their hands be upheld in every way possible, and that the force of inspectors be increased whenever and wherever necessary to safeguard those great interests.

We earnestly direct the attention of all fruit-growing bodies throughout the State and the coast to the situation, and urge upon them the utmost watchfulness and aid in actively supporting the good work now being done by the State and Federal quarantine officers."

To the rank and file of the horticultural quarantine division this tribute—to their sincerity of purpose, their collectivity of effort and adherence to a fixed policy of duty—from a body of broad minded men who had taken infinite pains to inform themselves of all the facts concerning the situation before arriving at these conclusions, is an incentive that will redound to the further protection of the allied horticultural and agricultural interests of California, and should present to the producers of this State the proper value, the fallacy and inconsistency of the assiduously published statements of certain agitated gentlemen that all of these same efforts are simply a matter of "political entomology." "Finis rationem excusat" is the motto of the quarantine division, and we of the service feel that the report of this grand jury has substantiated our belief that in so far as the Mediterranean fruit fly is concerned the end justifies the means.

SYNOPSIS OF WORK FOR MONTH OF JUNE, 1913.

SAN FRANCISCO STATION.

Horticultural imports.

		Parcels.
Ship inspected	31	
Passed as free from pests		53,324
Fumigated		2,476
Destroyed or returned		431
Contraband destroyed		25
Total parcels horticultural products for the month		56,256

Pests Intercepted.

From Honolulu—
- Larvæ of *Ceratitis capitata* in tomatoes.
- Larvæ of *Dacus cucurbitæ* in cucumbers.
- *Diaspis bromeliæ* and *Pseudococcus* sps. on pineapples.
- *Aphis* sps. on betel leaves.
- *Cylas formicarius* in sweet potatoes.
- *Cryptorhynchus batatæ* in sweet potatoes.

From Japan—
- *Aleyrodes citri*, *Parlatoria* sps. and *Pulvinaria* sps., on orange trees.

From Tahiti—
- *Lepidosaphes beckii* and *Morganella maskelli* on oranges.

From Florida—
- *Diaspis bromeliæ* and *Pseudococcus* sps. on pineapples.

From Mexico.
- Larvæ of *Trypetidæ* in mangoes.
- *Heilipus lauri* in avocado seeds.

From China—
- *Cylas formicarius* in sweet potatoes.

LOS ANGELES STATION.

Horticultural imports.

		Parcels.
Ships inspected	17	
Passed as free from pests		41,868
Fumigated		25
Destroyed		2
Returned		0
Contraband		0
Total parcels horticultural products for the month		41,895

Pests Intercepted.

From Belgium—
Diaspis zamiæ on *Cycas cercinalis.*
From British East Africa—
Crytorynchus mangiferæ in Mango seeds.
From Florida—
Lepidosaphes beckii and *Melanose* on pomelo.
From Illinois—
Chrysomphalus aurantii and *Parlatoria* sps. on palms.
From Massachusetts—
Pseudococcus citri on ferns.
From Maryland—
Pseudococcus longispinus on palms.
From Mexico—
Coccus hesperidum on palms.
From Pennsylvania—
Aleyrodes sps. on Gardenia.
From Tennessee—
Pseudococcus citri on ferns.

SAN DIEGO STATION.

Horticultural imports.

Ships inspected	15	
Passed as free from pests		12,889
Fumigated		2
Destroyed		2
Returned		0
Contraband		3
Total parcels horticultural products for the month		12,896

Pests Intercepted.

From Ohio—
Aspidiotus camelliæ on palms.
Mealy bug, *Aleyrodes* sp., and *Lepidosaphes* sp. on mixed plants.
From Pennsylvania—
Mealy bug on ornamental plants.
From Mexico—
Saissetia oleæ, *Pseudococcus* sp., *Aspidiotus* sp., *Lecanium* sp. on mixed ornamentals including croton, ivy, ferns.

SANTA BARBARA STATION.

Ships inspected ---------- 1
No horticultural imports.

EUREKA STATION.

Ships inspected ---------- None
No horticultural imports.

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VOLUME II No. 9

THE MONTHLY BULLETIN

Calosoma sycophanta Linn. which the State Insectary is endeavoring to establish in California as an enemy of many of the serious deciduous fruit tree caterpillars. (Photo by Vosler.)

OF

STATE COMMISSION OF HORTICULTURE

SACRAMENTO, CALIFORNIA SEPTEMBER, 1913

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STATE COMMISSION OF HORTICULTURE

September, 1913

THE MONTHLY BULLETIN

VOLUME II No. 9

DEVOTED TO THE DESCRIPTIONS, LIFE HABITS AND METHODS OF CONTROL OF INSECTS, FUNGOID DISEASES AND NOXIOUS WEEDS AND ANIMALS, ESPECIALLY IN THEIR RELATIONS TO AGRICULTURE AND HORTICULTURE.

EDITED BY THE ENTIRE FORCE OF THE COMMISSION UNDER THE FOLLOWING DIRECTORS:

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1913

THE FRUIT-TREE LEAF-ROLLER.

(*Archips argyrospila* Walker.)

Order—Lepidoptera. Family—Tortricidæ.

By Geo. P. Weldon, Chief Deputy State Commissioner of Horticulture, Sacramento, Cal.

Introduction.

This pest is frequently reported as injuring the foliage and fruit of various trees in different parts of the country, often becoming so abundant that acres of orchards are defoliated and the crop ruined. In New York State, Colorado, and New Mexico orchardists have known of its ravages for many years. It is not a pest that commonly remains bad in one place for a number of seasons, but when at its height there are few that can do more injury in a short time. For years it may occur in a locality and its presence will not be known by the orchardists; suddenly it begins to increase in numbers until it becomes a pest of the greatest importance and control measures are necessary to check it. Usually after from two to five years of its destructive work parasites have multiplied to such an extent that it is practically eradicated by them, and for a number of years there may be little or no damage from it. When conditions happen to be just right again, there will be an increase in numbers and thus there are cycles of good and bad years.

Occurrence in California.

On June 24th in company with State Horticultural Commissioner, Dr. A. J. Cook, and County Horticultural Commissioner from San Diego County, Mr. H. A. Weinland, the writer visited several orchards in the vicinity of Julian. In one of these the leaf-roller had ruined much of the fruit, the damage being more noticeable because of a light crop. The foliage was also damaged to a considerable extent. We were told that last season the insect had made its appearance in orchards of this same locality but in lesser numbers. At the time of our visit many moths, a few larvæ and pupæ and an abundance of freshly laid eggs were seen. Not much has yet been determined in regard to the distribution of this pest in the State. A few egg-masses have been seen on trees in a number of places, and an unauthenticated report of severe injury has come from a locality which we have not yet had a chance to visit in order to determine whether or not the pest which did the reported damage was the leaf-roller.

Occurrence in Other States.

In 1891 Prof. C. P. Gillette, of the Colorado Experiment Station, published a bulletin, No. 19, in which he told about a serious outbreak of the pest in northern Colorado. For about four years his records show that it was bad, then larvæ parasites appeared which soon overcame it, and since then it has not been a pest of any consequence in that particular locality. In Bulletin No. 311 of the Cornell Experiment Station, Prof. Glenn W. Herrick describes the pest and its ravages in New York and other Eastern States. Mr. John B. Gill, of the Bureau of Entomology, made studies of this insect in Colorado and New Mexico

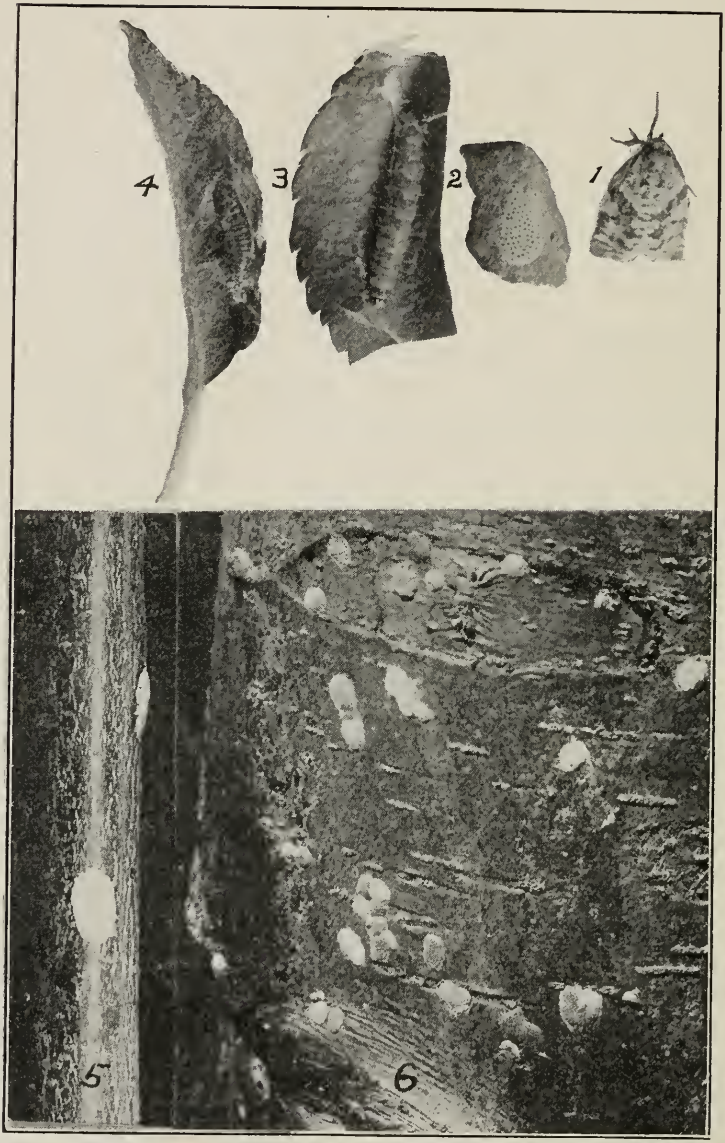

FIG. 357—The fruit-tree leaf-roller. 1, adult moth; 2, hatched egg mass on bark; 3, mature larva; 4, pupa; 5, light-colored egg masses on bark; 6, thirty-five hatched egg masses in a space of twelve square inches. (After Gillette and Weldon, Cir. 5, Colo. State Ent.)

and published a bulletin, No. 116, Part V. Prof. C. P. Gillette and the author of this article published, in 1912, life history records and results of laboratory and field experiments in Circular No. 5, Office of State Entomologist, Fort Collins, Colorado. Other references have been made to it by entomological writers from time to time, but probably nowhere has the damage been more serious than in Colorado and New Mexico during recent years. It is probable that only deciduous fruits would be attacked and of these the peach does not seem to be bothered to any extent.

The Egg Stage.

The fruit-tree leaf-roller passes the winter in the egg stage. In every case where its life history has been determined there is only one brood during a season, the eggs being laid in the summer and remaining unhatched until the following spring. Colorado records show that during the latter part of June and fore part of July most of the eggs are deposited. They may be found most anywhere on the bark of fruit trees, shade trees, shrubbery and berry bushes. When moths are abundant they frequently lay them on fence posts, barns, houses, etc. The writer has seen the side of a house, which during the summer season had been partly covered by a climbing rose bush, plastered so thick with egg masses that there were several hundred in a space of 10 or 12 square feet.

The individual masses are made up of from 10 to 150 eggs, all of which are covered with a sticky substance from the moth deposited with the eggs. This substance hardens and protects them in a compact oval or in some cases nearly circular flat mass, the greater diamater averaging about three sixteenths of an inch and the lesser one eighth of an inch.

When first laid the patches are generally greenish-yellow, but soon turn darker after exposure to the sun. There is quite a variation in color and many are light gray in the spring about hatching time.

Fig. 357, 5 and 6, shows a number of egg masses on apple tree. Fig. 357, 5, is from a picture of two very light colored masses; the upper one gives some idea of the thickness of an individual egg patch. In Fig. 357, 6, 35 egg masses are shown on the trunk of an apple tree in a space of about 12 square inches.

After the eggs are hatched the remaining shells may adhere to the trees for years. These may always be distinguished from the unhatched eggs by the perforations in the surface. The larvæ in emerging cut clean oval-shaped holes through the caps of the eggs so the number of holes in a mass indicates the number of larvæ that hatched from it. Fig. 357, 2, illustrates the appearance of a hatched egg mass.

The Larval Stage.

Shortly after the buds of fruit trees begin to burst open the tiny larvæ of the leaf-roller may be found feeding upon them. They do not all hatch at the same time, however, and there may be a period of two weeks or more during which hatching will be going on. At first the tiny worms are about one sixteenth of an inch in length and yellowish in color. Later they become a deep green with the head and thorax black or brown. On an average a little less than thirty days is required for the larvæ to become full fed. During the time they are feeding the leaves and fruit are attacked. Webs are spun and by means of these, bunches of leaves and fruit are tied together. These turn brown if the attack is severe and there is no chance for any fruit to mature. Complete defoliation of trees by this pest is not at all uncommon where nothing is done to check it. Fig. 357. 3, is from a photograph of a full grown larva on a leaf.

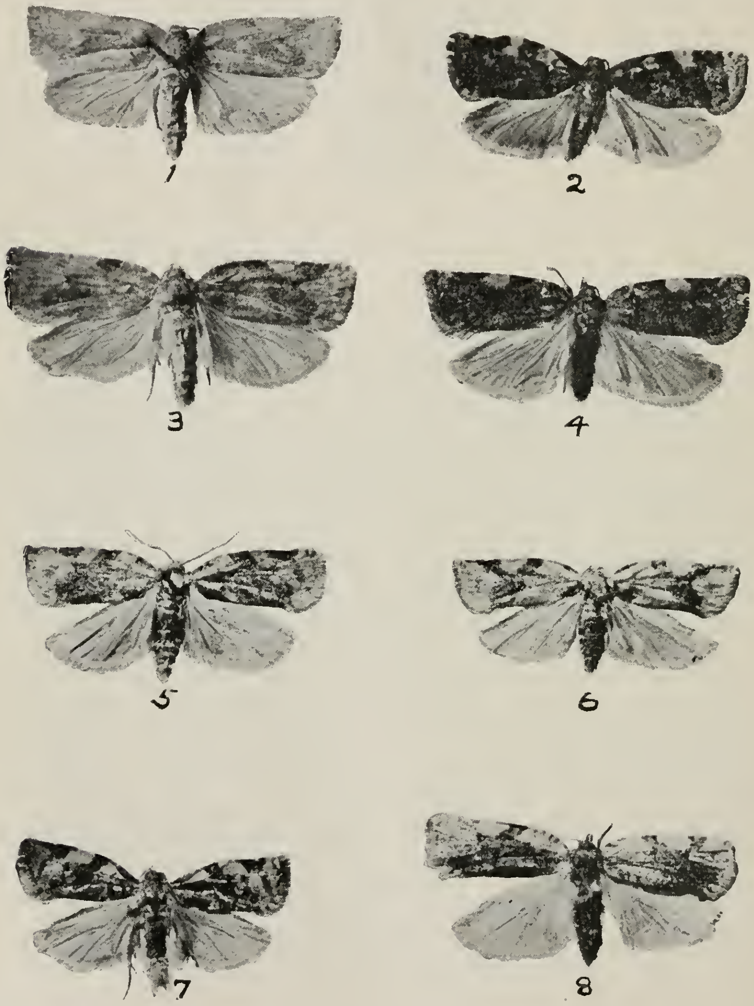

FIG. 358.—The fruit-tree leaf-roller. 1, light-colored female moth; 2, dark-colored male from same egg mass; 3, light-colored female; 4, dark-colored female from the same egg mass as 3; 2, 4, 5 and 7 showing most characteristic markings. (After Gillette and Weldon, Cir. 5, Colo. State Ent.)

The Pupal Stage.

After the larvæ have become full grown they change to the pupal stage within a rolled up leaf or cluster of leaves. At first they are green in color, later changing to a dark brown, and in about ten days transformation to the moth stage takes place. Fig. 357, 4, shows a pupa photographed on a leaf where this stage was being passed.

The Moth.

(Fig. 358.)

The following description of the moth is copied from Circular No. 5, Office of State Entomologist, on "The Fruit-Tree Leaf-Roller in Colorado," by C. P. Gillette and Geo. P. Weldon:

"The moths measure from ten to thirteen millimeters, or from three eighths to one half of an inch, in length, with the wings closed; the expanse of the full-spread wings usually varies between eighteen and twenty-five millimeters, or from eleven sixteenths to one inch; the prevailing color is a rusty brown, varying in typical specimens from rather light to quite dark, and there is always present a large pale-yellow to almost white diagonal patch on the front or caustal margin of the wing a little beyond the middle; a smaller light area occurs on the front margin of the wing about halfway between the large light area and the base of the wings; the two light areas are separated by a dark rusty-brown diagonal band or stripe; this stripe and an area just beyond the large light patch are usually the darkest portions of the wings; the dark-colored area is more or less broken or mottled with pale-yellow scales; the abdomen and lower surface of the hind wing are light yellow, but the upper surface of the hind wing is usually more or less dusky or smoky in color, especially toward the distal portions; the male averages smaller than the female and has the light and dark coloration more sharply contrasted; in the darkest females the smaller light-colored area on the wing is sometimes obliterated; in the lighter examples the distal portion of the wing is often distinctly yellowish in color, with a greater or less number of rusty-brown scales intermingled, this light portion frequently connecting with the larger light area on the anterior margin of the wing; in extremely light examples, which occur with some frequency, the entire surface of the fore wing is light yellow in color, with slight rusty outlines, as shown in Fig. 358, 1. There are occasional specimens with very contrasting colors, in which the ground color of the wing is light yellow and the dark markings somewhat in the form of a letter Y across the wing near the central portion, as shown in Fig. 358, 6. In all cases where these moths with the extreme light or dark colors have been reared we have obtained them from individual egg masses, from which the greater number of the moths had the typical color markings shown in Fig. 358, 2, 5 and 7. In all the examples we have reared, the very light-colored examples have been females, while it is not uncommon for the darker-colored individuals to be females also."

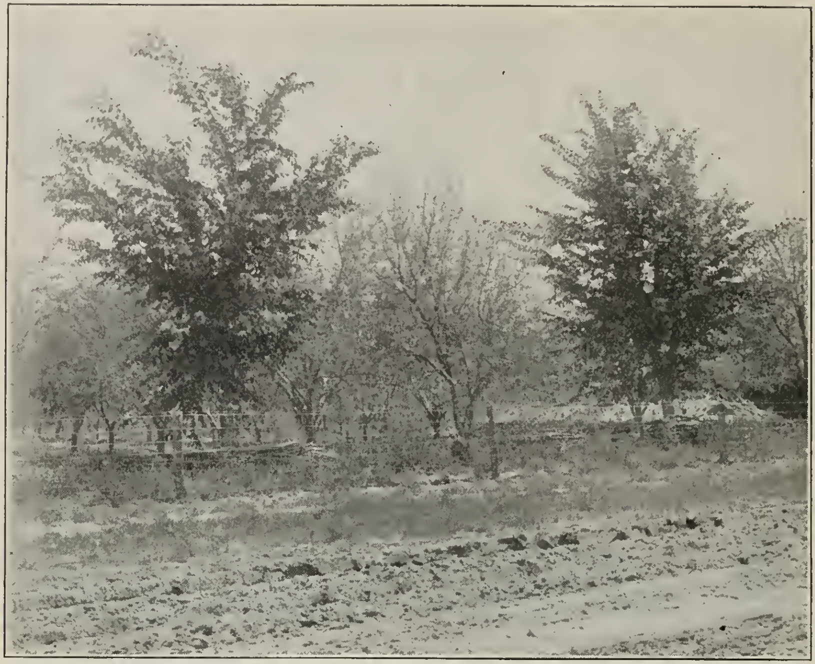

Fig. 359.—General view of orchard in which tree in Fig. 360 was photographed, showing defoliation of the fruit trees. The trees with the heavy foliage are elms, and were not attacked by the leaf-roller. (After Gillette and Weldon, Cir. 5, Colo. State Ent.)

Food Plants.

The fruit-tree leaf-roller is principally a fruit pest as its name indicates; it is quite an omniverous feeder, however, and may be found eating the foliage of many shade trees as well as herbaceous plants. Fig. 359 shows some elm trees which were not attacked alongside an apple orchard in which the foliage had practically all been destroyed at the time the picture was taken. In Circular 5, from Office of State Entomologist of Colorado, the following list of trees and plants which larvæ were found feeding upon is given: plum, cherry, pear, currant, gooseberry, raspberry, rose, poplar, elm, locust, alfalfa and onion. The alfalfa and onions were growing between tree rows where the larvæ had practically eaten all the leaves, and upon dropping to the ground webs were spun over everything with which they came in contact, and more or less feeding took place on all kinds of green plants. Fig. 360 illustrates this condition quite well.

Injury.

Something has already been said about the injury done to orchards by the leaf-roller. This injury assumes several different forms—

1. The blossoms are partly or wholly destroyed very early in the season.
2. The fruit and foliage are partly or wholly destroyed somewhat later.
3. The next season's crop is destroyed as well as the current season's.

The first form of injury which results in the destruction of the fruit also comes as a result of an abundance of worms which hatch very early and which begin feeding on the tender blossoms even before they have had time to open up. The organs of the flower are destroyed so that fertilization is impossible and the flowers and fruit have no chance to develop. The second form of injury is always found when the leaf-roller is present. Both the fruit and the foliage are fed upon. If the larvæ are abundant enough they may destroy all the leaves and fruit; if they occur in lesser numbers there may be a partial defoliation and the fruit may be injured more or less seriously. Apples will usually develop when they have been attacked, but are ill-shapen and unmarketable. Fig. 361 illustrates early attacks of the worms and later development of the fruit. The third form of injury is one that is not usually reckoned upon by the average fruit grower, and probably always follows complete defoliation. Several orchards in Colorado, which were badly damaged in 1912; in fact so badly that practically all the leaves

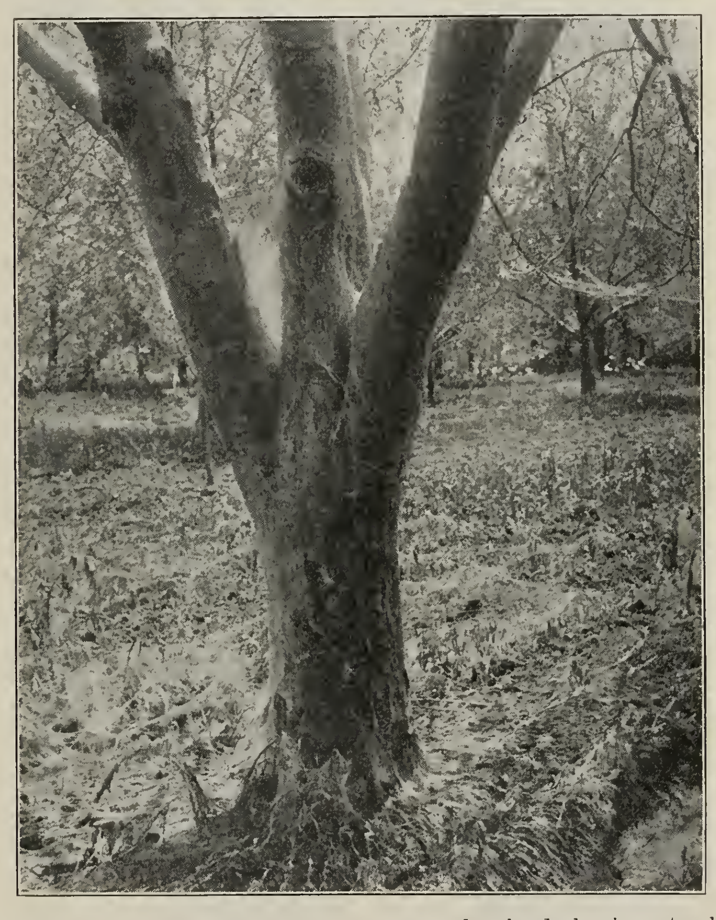

FIG. 360.—Photograph taken in an unsprayed orchard, showing a trunk covered with webs; also the alfalfa at the base matted down with them. All the foliage in this orchard was destroyed. (After Gillette and Weldon, Cir. 5, Colo. State Ent.)

turned brown and dried up, were examined in the late spring of 1913. Absolutely no fruit buds had developed the previous season, consequently the leaf-roller was responsible not only for the loss of the crop during the season when they defoliated the trees, but the succeeding season as well. These orchards inspected were treated during the spring of 1913 with a soluble oil spray so that the leaf-roller was practically eradicated and the foliage was fine, but no fruit was present. The fact that a severe attack by this pest during any one season may

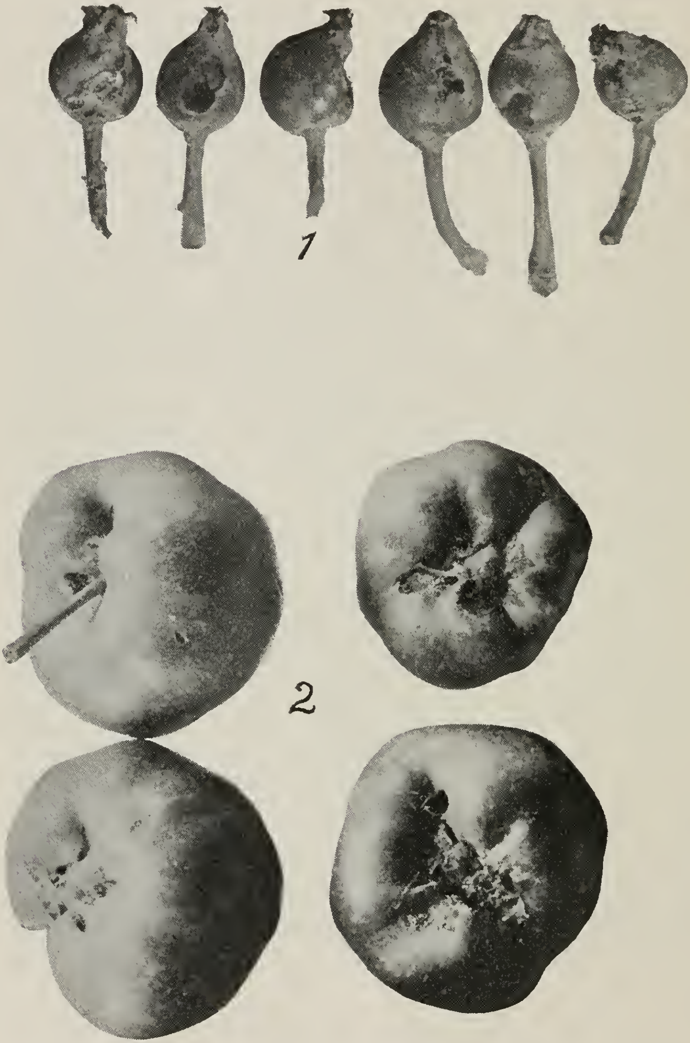

Fig. 361—Work of the fruit-tree leaf-roller on apples. 1, apples picked on June 8, when they were from five eighths to three quarters of an inch in diameter, showing the characteristic injury from the leaf-roller; 2, apples picked from the same orchard on August 9, when they were about two inches in diameter. (After Gillette and Weldon, Cir. 5, Colo. State Ent.)

mean the loss of two seasons' crops should be sufficient to impress upon any orchardist the necessity for using control measures just as soon as it appears.

Control.

Adequate means of control have now been worked out, and the damage that has been done in certain sections in the past, where there has been an outbreak of this serious insect, may be averted in the future. Certain sprays have proven to be effective in destroying the egg, still others the larvæ, and the orchardist who will do the spraying thoroughly with the materials recommended need have little fear of failure in protecting his crop.

SPRAYS TO KILL THE EGGS.

As the winter season is always spent in the egg stage, it was only necessary to find some spray which when applied during the dormant season, would kill them. A long series of laboratory experiments were carried through by Prof. C. P. Gillette in 1895, and by the writer in 1912; also a series of orchard experiments were conducted during the latter year. In these it was found that an oil spray of some kind or other, would penetrate through the tough, very impervious coating of the egg mass, and kill the eggs beneath. Various strengths of kerosene emulsion were used in the work with good results in some cases and not so good in others. The variable results attained with this material were such that it could not be recommended. While in some cases an emulsion containing a certain percentage of kerosene would kill all egg masses to which it was applied, in others the same strength of material in a different emulsion would fail to kill many of them.

Miscible Oils.

Nothing was found to be more effective in the work of killing the eggs than the various brands of the commercial products known as soluble or miscible oils. Of these preparations three kinds, viz, Target Brand Scale Destroyer, Scalecide and Carboleine were used with splendid success. Applications were made with various strengths and the results indicated that they should not be used weaker than one gallon of soluble oil to nineteen gallons of water. Fig. 362 shows a sprayed and unsprayed tree. The lower one was sprayed with Target Brand Scale Destroyer one part to nineteen of water.

This season before coming to California the writer helped in the work of spraying for the control of this insect in the worst infested sections of Colorado. In one of these every grower who was known to have leaf-roller in his orchard sprayed. Remarkable results were attained in all cases where spraying was thoroughly done. Some few people tried to get along with from three to five gallons of spray per tree where double the amount should have been used. They of course met with a certain degree of failure.

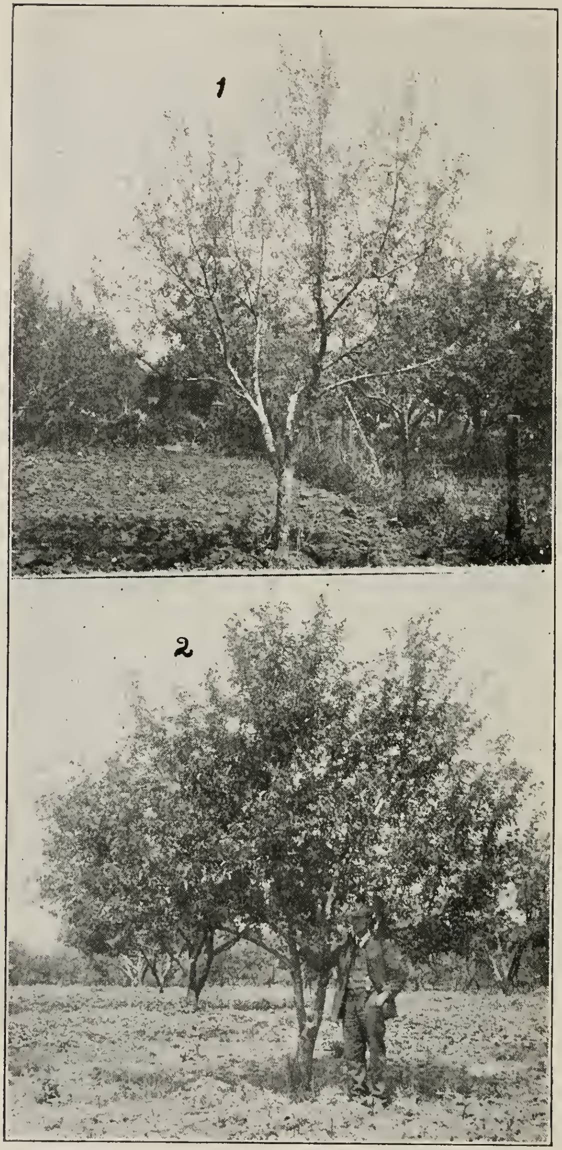

Fig. 362.—1, unsprayed tree in orchard, photographed on June 8; 2, tree sprayed with Target Brand soluble oil, photographed on the same date. (After Gillette and Weldon, Cir. 5, Colo. State Ent.)

Crude Oil Emulsion.

Some preliminary work was done to determine the effect of a good crude oil emulsion upon the eggs. These tests while not extensive enough for definite conclusions, indicated that such an emulsion would give excellent results. Two strengths were used, viz, 12½ and 16⅔ per cent. No specific gravity test was made of this oil. It was, however, the crude product just as it was pumped from the wells at Florence, Colorado. It is very probable that any of the good distillate or crude oil emulsions that are used successfully in the control of scale insects in California could be used to good advantage in destroying leaf-roller eggs also.

Lime and Sulphur Useless.

Owing to the fact that lime and sulphur has often been suggested as a remedy it seems well to mention in this article, the fact that many careful experiments have proven beyond a shadow of a doubt that this preparation is of no value at any strength in destroying leaf-roller eggs.

SPRAYS TO KILL LARVÆ.

As the larvæ feed upon the foliage it would seem that they could be easily controlled by means of an arsenical spray. They are found, however, to resist much stronger doses of arsenate of lead, etc., than many others of our chewing insect, *e. g.,* codling moth. It is possible to kill quite a large percentage of the worms when they are small, by very heavy applications of an arsenate of lead spray used at the strength of three pounds to fifty gallons of water. Trees when sprayed should be thoroughly drenched. It is important also that spraying begin just as soon after the eggs have begun to hatch as possible. Roughly speaking this will be very soon after the leaves have begun to come out in the spring. A second application should be made in the case of apples just before blooming and after the buds in the blossom clusters have separated one from another. The object of a spray at this time is to cover the entire surface of the blossom cluster with the poison in order that many of the larvæ which ordinarily feed upon the blossoms may be killed. The third arsenical spray for leaf-roller on apple trees will serve the dual purpose of a leaf-roller and codling moth spray and should be applied when 90 per cent of the petals have fallen and before the calyx cups close. Later sprays will do little or no good in controlling the pest, as the worms become very resistant to the poison as they get larger, and are well protected by curled leaves.

Black Leaf "40" was used with good success in the experimental work in Colorado, when the worms were very small. Two applications made at the time indicated for the first two arsenical sprays will kill a large percentage of the larvæ. It should be used at the strength of one part of Black Leaf "40" to eight hundred parts of water.

SPRAYING MUST BE THOROUGH.

Too much stress can not be placed upon thoroughness in spraying for this pest. They are so well protected by the folds of leaves in which they feed that it is only by the use of very heavy, drenching sprays that the larvæ may be killed. This does not apply so much to the spray to kill the eggs although in this case every mass missed endangers the tree that much more, and it does not take many of them when they hatch to produce enough larvæ to infest a tree seriously.

SULZER APPLE PACKING AND GRADE LAW.

SECTION 1. *Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That the standard barrel for apples shall be of the following dimensions when measured without distention of its parts: Length of stave, twenty-eight and one half inches; diameter of head, seventeen and one eighth inches; distance between heads, twenty-six inches; circumference of bulge, sixty-four inches outside measurement, representing as nearly as possible seven thousand and fifty-six cubic inches, provided that steel barrel containing the interior dimensions provided for in this section shall be construed as a compliance therewith.

SEC. 2. That the standard grades for apples, when packed in barrels which shall be shipped or delivered for shipment in interstate or foreign commerce, or which shall be sold or offered for sale within the District of Columbia or the territories of the United States, shall be as follows:

Apples of one variety, which are well-grown specimens, hand picked, of good color for the variety, normal shape, practically free from insect and fungous injury, bruises, and other defects except such as are necessarily caused in the operation of packing; or apples of one variety which are not more than ten per centum below the foregoing specifications, shall be "Standard Grade minimum size two and one half inches," if the minimum size of the apples is two and one half inches in transverse diameter; "Standard Grade minimum size two and one fourth inches," if the minimum size of the apple is two and one fourth inches in transverse diameter; or "Standard Grade minimum size two inches," if the minimum size of the apples is two inches in transverse diameter.

SEC. 3. That the barrels in which apples are packed in accordance with the provisions of this act may be branded in accordance with section two of this act.

SEC. 4. That all barrels packed with apples shall be deemed to be below standard if the barrel bears any statement, design or device indicating that the barrel is a standard barrel of apples, as herein defined, and the capacity of the barrel is less than the capacity prescribed by section one of this act, unless the barrel shall be plainly marked on end and side with words or figures showing the fractional relation which the actual capacity of the barrel bears to the capacity prescribed by section one of this act. The marking required by this paragraph shall be in black letters of size not less than seventy-two point one inch gothic.

SEC. 5. The barrels packed with apples shall be deemed to be misbranded within the meaning of this act:

First—If the barrel bears any statement, design or device indicating that the apples contained therein are "Standard Grade" and the apples, when packed, do not conform to the requirements prescribed by section two of this act.

Second—If the barrel bears any statement, design or device indicating that the apples contained therein are "Standard Grade" and the barrel fails to bear also a statement of the name of the variety, the name of the locality where grown and the name of the packer or the person by whose authority the apples were packed and the barrel marked.

Sec. 6. That any person, firm or corporation, or association who shall knowingly pack or cause to be packed apples in barrels, or who shall knowingly sell or offer for sale such barrels in violation of the provisions of this act, shall be liable to a penalty of one dollar and costs for each such barrel so sold or offered for sale, to be recovered at the suit of the United States in any court of the United States having jurisdiction.

Sec. 7. That this act shall be in force and effect from and after the first day of July, nineteen hundred and thirteen.

PAJARO VALLEY APPLE GRADE RULES.

The committee formed for the purpose of establishing grades or standards for Pajaro Valley apples, after hearing all parties interested and after taking into consideration the character of our fruit and the markets it is destined to reach, begs leave to submit the following report, which report has been approved and adopted by the four fruit-growers' associations now formed in Santa Cruz County, viz:

Corralitos Fruit Growers' Association.
Carlton Fruit Growers' Association.
Casserly Fruit Growers' Association.
Soquel Fruit Growers' Association.

Fancy or No. 1 Grade.

Apples placed in this grade must be mature and of normal shape for the variety and free from defects except leaf and limb rub, russet and similar defects which have not distorted the fruit and which do not aggregate more than one half inch in diameter, will be allowed. Wormy apples must be excluded from this grade, also all apples less than two and one fourth ($2\frac{1}{4}$) inches in diameter.

No. 2 Grade.

In this grade may be placed all merchantable apples not included in the fancy or No. 1 grade. All apples must be free from bruises with skin unbroken and of good shape. Sizes smaller than two and one half ($2\frac{1}{2}$) inches not allowed.

Boxes.

We recommend the adoption, as far as possible consistent with cleaning up shooks now on hand, of the Northwestern standard box, which is ten and one half ($10\frac{1}{2}$) inches by eleven and one half ($11\frac{1}{2}$) inches by eighteen (18) inches inside measurement, and the diamond or diagonal pack, and we further strongly recommend that each grower provide himself with orchard picking boxes, to the end that our fruit shall reach the markets in bright, new and clean boxes.

Proper Marking.

In marking boxes, care should be taken that all marks are placed in a neat manner and in the proper place; the grower's name (if desired), the grade, variety and number of apples in the box should appear on the labeled end of the box, above the label. We suggest that the following rule be adopted:

John Doe, or No. 21.	Fancy.	Bellefleurs. 112.

All boxes containing apples graded fancy must bear the Association label on the end of the box.

Inspection.

Each box containing fancy grade apples shall bear with it an inspection certificate, reading as follows:

Official Inspection Certificate.

The apples in this box have been packed by Packer No. ————, and we hereby guarantee the contents to conform to the standard adopted by us on April 19, 1913, and which is as follows: (wording of grade).

Signed __________________________ Association.

*RULES AND SPECIFICATIONS FOR GRADING AND PACKING APPLES.

Adopted by North Pacific Fruit Distributors.

After four days' consecutive work, the managing board of the North Pacific Fruit Distributors announced the following rules and specifications for grade and pack of apples to be handled through the organization. The grades to be used will be designated as extra fancy, fancy and C grades, corresponding to Nos. 1, 2 and 3, defined as follows:

Extra Fancy.

This grade shall consist of sound, smooth, matured, clean, handpicked, well formed apples only, free from all insect pests, disease, blemishes, bruises and other physical injuries, stings, scald, scab, sun scald, dry or bitter rot, worms, worm holes, decay, spray burn, limb rub, water core, skin puncture or skin broken at stem. All apples must be of good matured color, shape and condition characteristic of the variety. The following varieties defined as to color shall be admitted to this grade:

Solid Red Varieties—Aiken Red, Arkansas Black, Black Ben Davis, Fall Wine, Gano, Jeniton, Jonathan, King David, Mammoth Black Twig, Missouri Pippin, Oregon Red, Spitzenburg (Esopus), Steele Red, Vanderpool.

Striped or Partially Red Varieties—Ben Davis, Delicious, Gravenstein, Hubbardson Nonesuch, Jeffries, King of Tompkins County, McIntosh Red, Northern Spy, Rome Beauty, Stayman, Snow, Wagener, Wealthy, York Imperial.

Color requirements for extra fancy are as follows:

Solid red varieties to have not less than three fourths good red color and the size of 175 and smaller when admitted to the grade to have at least 90 per cent good red color.

---

*From the Northwest Horticulturist, August, 1913.

Striped or partially red varieties as designated above to have not less than one half good red color; when the size of 175 or smaller is admitted to this grade they must have at least three fourths good red color.

Except that Gravensteins, Jeffries and King of Tompkins County in all sizes must be at least one third good red color.

Red cheek or blushed varieties, such as Hydes King, Red Cheek Pippin, Winter Banana, Maiden Blush, must have a red cheek.

Ortleys must be white, yellow or waxen.

Yellow or green varieties, such as Grimes Golden, White Winter Pearmain, Yellow Newtown and Cox's Orange Pippin must have the characteristic color of the variety. No sizes admitted to this grade smaller than as follows:

Aiken Red, 200; Arkansas Black, 175; Ben Davis, 163; Black Ben Davis, 163; Cox's Orange Pippin, 163; Delicious, 150; Fall Wine, 200; Gano, 163; Grimes Golden, 200; Gravenstein, 200; Hubbardson Nonesuch, 163; Hydes King, 150; Jeniton, 200; Jonathan, 200; Jeffries, 225; King of Tompkins County, 163; King David, 200; Mammoth Black Twig, 150; Missouri Pippin, 200; McIntosh Red, 200; Maiden Blush, 163; Northern Spy, 150; Oregon Red, 175; Ortley, 175; Rome Beauty, 163; Red Cheek Pippin, 163; Spitzenburg (Esopus), 200; Steele Red, 163; Stayman, 163; Snow, 225; Vanderpool, 163; Winesap, 225; Wagener, 200; Winter Banana, 150; White Winter Pearmain, 200; Wealthy, 200; Yellow Newtown, 225; York Imperial, 163.

All boxes to be lined and cardboard to be used top and bottom.

Fancy Grade.

In the grade all apples must be matured, hand picked, clean and sound, free from insect pests, water core, sun damage, broken skin, scald, scale, dry or bitter rot, worms, worm stings, infections, diseases and all other defects equally detrimental, excepting that slight limb or leaf rub, scratches or russeting will be permitted provided that no apple shall show total blemishes aggregating more than one half inch square. Fruit clearly misshapen, bruised or bearing evidence of rough handling shall not be permitted in this grade.

The varieties admitted to this grade are the same as in the extra fancy. All boxes are to be lined and cardboard to be used top and bottom.

Color requirements are as follows:

The solid red varieties must have fully one third of good solid red color. Striped or partially red varieties must have at least one fourth of good red color. All apples of a green or yellow variety shall be of characteristic color.

No sizes shall be admitted to this grade smaller than as follows: Aiken Red, 175; Arkansas Black, 163; Ben Davis, 150; Black Ben Davis, 150; Cox's Orange Pippin, 150; Delicious, 150; Fall Wine, 175; Gano, 150; Grimes Golden, 175; Gravenstein, 175; Hubbardson Nonesuch, 150; Hyde's King, 150; Jeniton, 175; Jonathan, 175; Jeffries, 200; King of Tompkins County, 150; King David, 175; Mammoth Black Twig, 150; Missouri Pippin, 175; McIntosh Red, 175; Maiden Blush, 150; Northern Spy, 150; Orange Red, 163; Ortley, 163; Rome

Beauty, 150; Red Cheek Pippin, 150; Spitzenburg (Esopus), 150; Steele Red, 150; Stayman, 150; Snow, 200; Vanderpool, 150; Winesap, 200; Wagener, 175; Winter Banana, 150; White Winter Pearmain, 175; Wealthy, 175; Yellow Newtown, 200; York Imperial, 150.

Single Grade.

The following apples to be packed in one grade, combining the extra fancy and fancy grades as provided by these grading rules, size not smaller than 163 count, windfalls absolutely excluded. This pack to be marked or labeled as "Fancy": Apple of Commerce, Baldwin, Ben Hur, Bismarck, Canada Red, Chicago, Champion, Delaware Red, Golden Russet, Hoover, Ingram, Kaighn Spitzenburg, Kentish, Kinnard, Mann, Mother, N. W. Greening, Pewaukee, Pryor Red, Rambo, Rhode Island Greening, Roy Russett, Russian Red, Salome, Shakelford, Senator, Stark, Swaar, Wallbridge, Westfield, Willow Twig, Yellow Bellefleur, McMahon.

Exceptions.

Summer varieties such as Astrachan, Bailey's Sweet, Beitigheimer, Duchess, Early Harvest, Red June, Strawberry, Twenty-Ounce Pippin, Yellow Transparent and kindred varieties not otherwise specified in these grading rules, together with early fall varieties, such as Alexander, Blue Pearmain, Wolf River, Spokane Beauty, Fall Pippin, Waxen, Talman Sweets, Sweet Bough and other varieties not provided for in these grading rules as grown in sections of early maturity, shall be packed in accordance with the grading rules covering fancy grade as to defects, but regardless of color rules; size not smaller than 163 count for the larger growing varieties and 225 count for the smaller growing varieties; windfalls to be absolutely excluded. All boxes to be lined and cardboard used top and bottom.

C Grade.

This grade is provided to be used when market requirements justify and shall consist of apples not smaller than 163 count. This grade shall be made up of all merchantable apples not included in extra fancy or fancy grades. Apples must be free from all insect pests, worms, worm holes, and infectious diseases. Serious physical injuries, skin puncture, bruised or broken skin will not be permitted, and not exceeding two stings, thoroughly healed. There are no requirements as to color except that the fruit must be matured. This grade to be packed in accordance with trade requirements.

Indorsements.

Your executive board advises the use of the regular Northwestern standard box in all sections, inside measurements 10½ by 11½ by 18, with solid ends. We believe that we should make this the uniform box as standard in all sections. Inasmuch as the laws as well as the trade requirements will force us to sell our apples by numerical count, we abolish the system of designating or manifesting fruit by tiers and we employ the numerical system exclusively hereafter.

The recognized and indorsed counts for the Northwestern standard apple pack are as follows: 36, 45, 48, 56, 64, 72, 80, 88, 96, 104, 112, 113, 125, 138, 150, 163, 175, 188, 200, 213, 225.

Crab Apples.

These should be carefully assorted as to varieties, making one grade only, keeping out all insect pests, worm holes, sting, scale, misshapen and blemished fruit. Put up in apple boxes; line the box; fill in gently, so as to prevent bruising.

Lady Apples.

These should be packed in half boxes, boxes lined, remembering that the more attractive the better the sale. Make only one grade, keeping out all insect pests, worm holes, sting, scale, misshapen and blemished fruit.

A CONSTANT MENACE.

By Frederick Maskew, Chief Deputy Quarantine Officer.

Among many other articles of freight, the Steamship Ventura brought to San Francisco from Honolulu a crate of fresh pineapples consigned to R. I. Lillie, Stewart Hotel, San Francisco. In common with all importations of horticultural products this crate and its contents were inspected and as a result forty live *Spenophorus rhabdocnemis obscurus* Boisd., the Hawaiian sugar-cane borer, were found in the package. These insects were fully one half inch long, and of several shades of rich brown in color, which made them easy of detection. The package, its contents and the weevils were promptly destroyed.

It is not the purpose of this article to detail the biology of this pest or to speculate on whether it might have adapted itself to host plants other than the sugar cane had it passed into this State undetected, but rather to point out that every vessel, every person, every automobile, box, crate, bundle, sack and package arriving from Hawaiian ports is a potential danger to the horticultural interests of California.

There is no record extant of this species of weevil attacking pineapples, and it is our opinion that this crate of pineapples had been placed after packing in some location where these insects occurred and the forty specimens we captured had entered the crate as a place of hiding. There is no record of the Mediterranean fruit fly infesting pineapples in Hawaiian territory, but if the packing is done, or the material used in packing is stored, or the packed cases are stored in the vicinity of any material infested with this pest, the larvæ on seeking a place to pupate are just as likely to wriggle themselves in the crevices of the crates as did the specimens of weevils we found. All pineapples destined for California points are subjected to a fumigation at San Francisco, with a strength of gas fully three times as great as that used on the citrus trees in California before they are released from the dock, but I doubt if even that strength would destroy the Mediterranean fruit fly in its pupal stage if any were secreted in the crevices of the crates. A box of soap purchased in a Chinese store in Honolulu, where it has laid in close contiguity to a sack of peppers infested with the maggots of the fruit fly, may contain pupæ of this pest, and is just as likely to bring the fly over in safety as a specimen of fruit infested with the larva. Here at quarantine in San Francisco we have found the pupa of the Mediterranean fly attached to the seams on the inside of gunny sacks that had contained bell peppers, and, as a result of this finding, refuse to release from the docks any material arriving from Hawaiian territory packed in old or used sacks. All such material must be emptied out, repacked in California sacks, the original sacks cut in four pieces, sent to the incinerator and burnt before the material is released by the quarantine officers.

If Hawaiian producers continue to seek a market in California for such of their products as are at present immune from the attacks of the Mediterranean fruit fly, California should insist upon an official record that every shipment of all such products, from the time they were cut in the field, through all the processes of packing, hauling and storing, had not been in the immediate vicinity of any material infested with the Mediterranean fruit fly.

No one comprehends more clearly than the writer that laws, rules or regulations made in California are not susceptible of enforcement in Hawaii, but the fact remains that in this particular instance, although California failed to take advantage of this position at the outset, the State is still master of the situation and can always decide as to what products shall enter this port.

THE RED-HUMPED CATERPILLAR.

(*Schizura concinna* S. & A.).

Order—Lepidoptera. Family—Notodontidæ.

By E. J. Vosler, Assistant Superintendent, State Insectary.

Summary.

1. Considerable damage is often done during this season of the year by the red-humped caterpillar on walnut, apple and allied plants.

2. The work of this insect consists in the stripping of the leaves from the branches of its host plant.

3. The larva is easily recognized by the coral-red hump on the fourth segment (first abdominal segment). The head is of the same color and the body striped with slender bands of black, yellow and white. There are two rows of prominent black tubercles along the back and shorter ones on the sides.

4. The pest is abundant during June, July, August and a part of September.

5. It is distributed over practically the whole United States, but seems to be confined to the central portion of this State.

6. Control measures consist in hand-picking on small trees and by the use of arsenical sprays in large orchards where the former procedure is impracticable.

7. Natural enemies are abundant and are important factors in the control.

Injury.

The damage caused by the insect varies considerably; sometimes the entire trees are defoliated, and then again just one small branch is attacked, the insect disappearing before all the leaves have been consumed. This latter appears to be the case around Sacramento on walnut trees, where only a few branches on the trees were defoliated, the injury done being of little economic importance.

Work.

The work of the larvæ consists in the partial defoliation of the host, particularly during July and August. Sometimes entire branches are stripped of their leaves, the larvæ leaving only the tough mid-ribs. The young larvæ begin feeding generally at the tips of the branches where the foilage is tender, gradually working down toward the base of the branch.

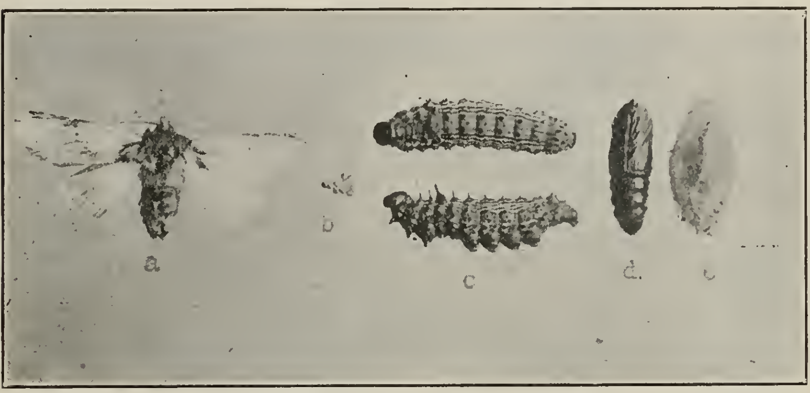

FIG. 363. The red-humped caterpillar, *Schizura concinna* S. & A. a, adult moth; b, egg cluster; c, larvæ or caterpillars; d, pupa; e, cocoon. About natural size. (Original.)

Description.

The adult moth, Fig. 363, a, is of an inconspicuous grayish and brown color; length of body, approximately, five eighths of an inch; wing expanse, one and a fourth to one and three eighths inches. The eggs, Fig. 363, b, are about the size of an ordinary pin-head; are light in color and are deposited in masses on the leaves. The full grown larva, Fig. 363, c, varies in length from one and a fourth to two inches. The head is coral red, being the same color as the fourth segment (first abdominal segment), which is enlarged so as to form a distinct hump. The pupa, Fig. 363, d, is tan to dark brown in color. Length, five eighths to three fourths of an inch. The cocoon, Fig. 363, e, inclosing the pupa, is of a parchment-like texture, being made of small whitish thread secreted by the larva. Length, about seven eighths of an inch.

Life History.

The moths emerge in May, June and July and deposit their eggs in clusters on the leaves. The larvæ are voracious feeders, rapidly consuming the leaves. When not eating they are to be found bunched together on a leaf, which can be picked off and consequently the whole colony destroyed. As the larvæ become older, the tendency to remain bunched together is not so marked. They are most abundant in June and July, the number gradually decreasing until September, when they become quite scarce. During the last of July and the following two months larvæ become full grown, drop to the ground where they transform to the pupal or resting stage in a thin cocoon. These

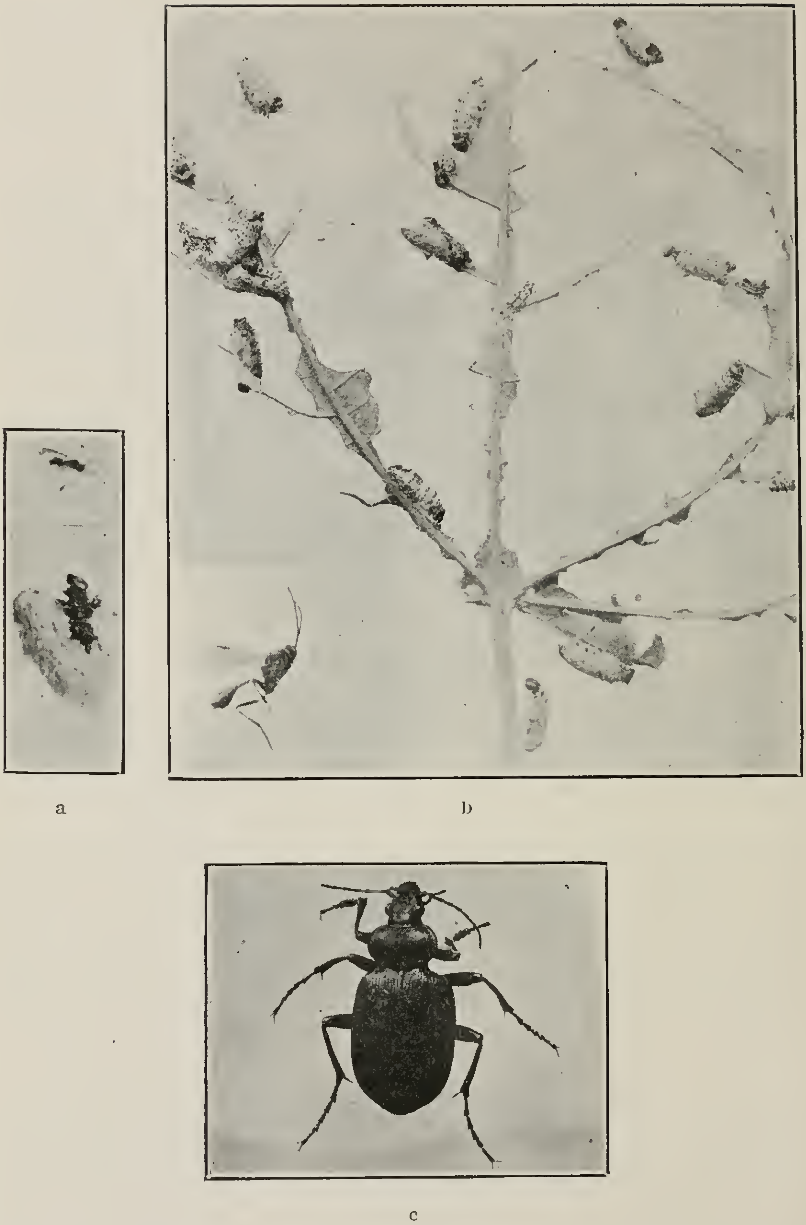

FIG. 364.—Natural enemies of the red-humped caterpillar, *Schizura concinna* S. & A. a, showing caterpillar with cocoons of *Apanteles* sp. and the adult parasite; b, cocoons of *Limnerium* sp. enclosed by the remains of the dead caterpillars still clinging to the twigs and adult of *Limnerium* sp.; c, imported enemy, *Calosoma sycophanta*, of the red-humped caterpillar. (Original.)

cocoons are found from one to three inches under the ground, or among the rubbish and leaves under the trees. The winter is passed as a pupa, the adult emerging in the late spring and early summer.

Control.

This pest is easily controlled by hand-picking, which is to be commended for use on small trees. On large trees, of course, this would be impossible, and arsenical sprays can be used. Arsenate of lead, using a strength of five pounds to one hundred gallons of water, will do the work admirably.

Distribution.

The red-humped caterpillar in California is common in the central portion of the State. It is well distributed over the whole United States.

Food Plants.

Mr. E. O. Essig[1] gives the following food plants: Apple, hawthorne, prune, plum and cherry. Some damage is also done to the walnut trees by this insect.

Natural Enemies.

Late in July and August the natural enemies of the red-humped caterpillar are abundant and exercise an important factor in its control. One parasite which does a great amount of good is *Apanteles* sp. (Fig. 364, a), belonging to the family *Braconidæ* of the order *Hymenoptera*. Numerous individuals emerge from a single larva and spin their whitish cocoons near or on the body of the host. Fig. 364, a, shows the cocoons of *Apanteles* with the remains of the host, also the adult insect.

Another important parasite is *Limnerium* sp. The cocoons of this parasite clustered on a branch, together with the adult parasite, are shown in Fig. 364, b. Unlike *Apanteles,* only one *Limnerium* emerges from each host.

The State Insectary has recently imported a predaceous beetle which we hope will prove of value as an enemy of the red-humped caterpillar. It feeds on this host in both the larval and adult stages. The adult of this beetle is shown in Fig. 364, c, and is only known by its scientific name of *Calosoma sycophanta.*

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[1] Injurious and Beneficial Insects, Monthly Bulletin, State Commission of Horticulture, 1913, Volume 2, Nos. 1 and 2, page 188.

THE FRUIT-TREE BARK-BEETLE.

(*Scolytus rugulosus* Ratz.)

Order—Coleoptera. Family—Scolytidæ.

By E. O. Essig, Secretary, State Commission of Horticulture.

The fruit-tree bark-beetle or shothole borer has just been reported as working upon apricot trees at Ontario, California, by Dr. Edwin C. Van Dyke, of the University of California. To our knowledge, this is the first authentic report made of this beetle in California, and is, therefore, of considerable importance.

The beetles are very small, being one tenth of an inch long and about one third as wide. The body is black, except that the tips of the wing covers and portions of the legs are red.

This insect usually attacks trees which are weak and such afford excellent breeding places. But from these the beetles spread to healthy trees and often do much harm in killing the young branches in the spring by booring into the tips. Young orchard trees are more susceptible to attack than are old and vigorous trees.

The presence of the beetle is indicated by the many small holes in the bark from which more or less gum exudes. Underneath the bark there are numerous tunnels extending in all directions and which work destruction to the trees.

Control is not easy, but the most important steps to be taken are to eliminate, by burning, all badly infested trees or portions, together with all the dead wood to reduce the numbers and spread.

Healthy trees which have become infested may often be saved by thoroughly spraying the trunk and limbs with a carbolineum emulsion prepared by dissolving three pounds of naphtha soap in three gallons of boiling water, to which is then added one gallon of carbolineum. Agitate this thoroughly and dilute with four gallons of water. Sprayers must be protected, as the carbolineum is severe on exposed parts of the body.[1]

As repellents, whitewash, bordeaux paste or a thick soap wash containing one pint of crude carbolic acid to every ten gallons, may be used and afford protection to young trees. The application of any of these repellents should be made in October or November.

Besides apricots the bettle attacks the plum, pear, peach, apple and cherry.[2]

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[1] Insect Pests of Farm, Garden, Etc., by E. D. Sanderson, p. 546.

[2] Injurious Insects, by W. C. O'Kane, p. 241.

GENERAL NOTES.

THE CODLING MOTH ATTACKING WALNUTS

It is not generally known by orchardists that the codling moth often attacks the green soft-shelled walnuts on the tree. Infestations are often serious and cause considerable loss.

We are just in receipt of some nearly mature Santa Barbara soft-shell walnuts from Carpinteria, California. They were collected by C. W. Beers, Horticultural Commissioner, who informs us that the infestation is limited to an area about one half mile wide and extending along the foothills with scattering infestations along the borders of this area.

The larvæ or "worms" work near the stem end and burrow through the green hull and often into the kernel of the nut, thus causing complete ruin. Clusters are apparently preferred to single nuts.

A similar attack has been recorded as occurring in Contra Costa County on October 2, 1909, by W. S. Foster, who has given a complete account of the nut-feeding habits of the codling moth in Bulletin No. 80, Part V, Bureau of Entomology, United States Department of Agriculture, September 20, 1910. In this bulletin we are furnished the following data:

1. The codling moth, besides attacking pome fruits (apples, pears, etc.), also attacks peaches, plums, chestnuts and the following variety of walnuts: Mayette, Concord, Franquette and Parisienne. (The Santa Barbara soft-shell is now also added to the list.)
2. The larvæ work in the green fleshy hull, some never going through the shell, but the majority boring through the soft shell and feeding upon the kernel inside.
3. The worms attacking walnuts are usually of the later broods issuing from the first broods of apples and pears. They, therefore, appear late in the nuts in August and September.
4. Hibernation takes place inside the walnuts or attached to the shells on the outside. The adults emerge in April and May.
5. In Contra Costa County it was a practice of pear growers to save windfalls and culls, which were stored in trays or covered with straw. From these the adult moths emerged and laid the eggs, giving rise to the broods attacking the walnuts.
6. Destroying the culls and windfalls will greatly lessen the attacks. Spraying with arsenate of lead in August will also probably serve as a means of control.

It is also probable that in localities where little attention is paid to spraying home apple and pear orchards or trees, that there will be more or less likelihood of the later broods attacking the walnuts, as is apparently the case at Carpintéria.

Cleaning up these sources of infestation should largely eliminate serious attacks.—E. O. Essig.

RESIGNATION OF PROFESSOR H. S. FAWCETT.

Before I ever thought to occupy the important position of State Horticultural Commissioner, I had noted the alarming havoc wrought by bacteria and other fungi in some of the citrus groves of California. I wished at that early day that we might have the most able mycologist of the world to grapple with these potent pigmies—a man to camp out, so to speak, in the orchard, and fight the fight to the finish.

Upon assuming the duties of this office I hastened at once to bring to our aid the right man. I had long noted and admired the monumental work of Professor H. S. Fawcett in Florida. I can not express my sincere gratification at his acceptance of our call to this position. I felt sure we had won a prize. I need not depict to our readers how thoroughly Professor Fawcett has met our hopes and desires. The investigation by Professor Fawcett of gummosis of the lemon has proved him a master in scientific research. He has demonstrated absolutely the fungoid nature of this disease, and though he does not claim with the same confidence that he has demonstrated, that a cure is as surely discovered, yet we feel that such is the case.

Doctor G. Harold Powell states that four epoch-making events in the history of our California citrus industry have occurred: Introduction of the navel orange; establishment of co-operative marketing; method of preserving the lemon, and discovery of cause and cure of gummosis, by Professor Fawcett. I would add Doctor Powell's own work of demonstrating efficiency, of careful handling to prevent decay in shipping citrus fruit, and the introduction of Vedalia.

I felt sure that Professor Fawcett was just the kind of a man that Doctor Webber would desire in the citrus station in southern California. I knew that his opportunities in the University would be augmented. I also felt, with Doctor Hunt, that Professor Fawcett's work was really that of the University. I therefore proposed to Doctor Webber that if he desired, Professor Fawcett might be transferred to the University staff of workers. I only asked that he be retained in the precise field of labor that has engaged his efforts in this Commission. This secured the happy blending of practical field work, and the necessary attendant research service. Both Doctor Hunt and Doctor Webber were pleased with this suggestion, and the transfer was made.

I have only to add that Professor Fawcett is as delightful and companionable as a man as he is able as an investigator. He is honesty itself; like all really great men, a model of modesty, an untiring worker. He has endeared himself to us all. It is with very great reluctance that we are to part company with our esteemed fellow-worker—A. J. Cook.

A NEW BEGINNING IN THE IMPORTATION AND ESTABLISHMENT OF BENEFICIAL INSECTS..

The mission of H. S. Smith, Superintendent of the State Insectary, to the Orient, in search of beneficial insects, is of very great importance to the farmers of this State, and renewing a common-sense policy of fighting insect pests inaugurated in this State in 1887, by the first introduction of the Vedalia from Australia, and which saved to California the great citrus industry.

Comparatively speaking, there are very few persons in the State at the present time who witnessed the downfall of the orange and lemon groves under the attack of the cottony cushion scale (*Icerya purchasi*) from 1885 to 1887, and it might be of interest to the present-day readers to again publish what the Los Angeles poet, Mr. Kercheval, once wrote about the ravages of the cottony cushion scale:

"*More deadly than the hordes of Goths and Huns that came to plow Rome and harrow Italy, came the countless legions of Icerya, and shriveled foliage and bare and blasted boughs everywhere told of their resistless and ruthless march. No watchfulness or vigilance could guard against their attacks, or turn them from their victorious course. Then in the deep night of our despair came a miracle and relief. As silent and noiseless as came the Angel of Death to smite the Assyrians beleaguering God's chosen people so came the Vedalia to our aid, and like Sennacherib's countless hosts, the cottony cushion legions, almost in a night, melted away and were no more. What a vast army of men and millions of dollars could not have performed in years, a mere handful of Australian ladybugs has virtually accomplished in a few weeks, and even to us, who have watched their work most closely, it seems utterly incomprehensible, and almost beyond belief.*"

That there exists in the Orient the various scale insects which are such serious pests in some sections of this State to citrus culture has been proved beyond question, and not a single species is a pest in that region—the red, purple, black scale and the citrus mealy bugs all being held in complete subjection by natural checks—and there is no good reason why we should not be able to transplant and establish some, if not all, of these natural checks into this State by a man of Mr. Smith's ability.—GEORGE COMPERE.

A NEW PARASITE OF THE BLACK SCALE.

The importance of a parasite of the black scale, *Saissetia oleæ* Bern., which will destroy the immature form, can not be overestimated.

Scutellista cyanea, the egg parasite of the black scale, which is so common, does not hold the pest in check for two main reasons: *first,* that the larva of the parasite reaches maturity in many cases without destroying all the eggs of the host, thus permitting enough of the young scale to escape to reinfest an orchard, even if one hundred per cent of the scaled showed the exit holes of the parasite; *second,* that the percentage of parasitism of the black scale by *Scutellista cyanea* rarely averages above eighty or eighty-five per cent. From these facts it can be easily seen why the black scale remains a pest year after year in our groves. Also, the percentages of parasitism is lessened by other factors, as secondary parasites, humidity, temperature, etc. Moreover, the efficiency of the *Scutellista* can only be judged by its capacity in reducing the progeny of the scale. The young scales hatch and will cause great injury to the host by sucking the sap and will have secreted all the honey-dew on which the black smut lives before the parasite has its inning.

The State Insectary has been in the past and is now making every effort to secure and establish a parasite which will kill the immature scale. On August 19th, through the kindness of Mr. H. A. Ballou of the Imperial Department of Agriculture of the West Indies, we received a small shipment of half-grown black and hemispherical scales parasitized by *Zalophothrix* sp., which is not unlike our own *Comys fusca*, the parasite of the brown apricot scale, in habits. We have now on hand a number of adults of *Zalophothrix* and an attempt will be made to establish them in California.—E. J. VOSLER.

MELANOSE (Stem-End Rot).

Melanose, a common disease of nearly all varieties of citrus fruit in Florida, though not yet in California, is now discovered to be caused by the same organism that produces the serious affection, Stem-End Rot (Florida Bulletin No. 111). Melanose is characterized by small black dots ringed with white, the rings invisible to the naked vision. In itself it does no harm except a slight disfigurement. Stem-end rot attacks the mature, or nearly mature, fruit in the grove, in storage or after shipment. As it destroys all our common varieties of citrus fruit, we should try in every way to keep it from California. This is why we bar out all Florida fruit that shows Melanose. Of course, we are most menaced by grape fruit, as no other is likely to be shipped into our State. All of our county horticultural commissioners must be on the lookout for Melanose, and should at once learn to detect it, in case this fungus comes into any of our citrus districts.—A. J. COOK.

ARIZONA COMMISSION OF AGRICULTURE AND HORTICULTURE.

PRESS CIRCULAR NO. 4. FEB. 8, 1913.

Arizona Inspection Practices Relating to Crown Gall.

Nearly all deciduous fruit growers are familiar with the tree disease known as "crown gall." This trouble is caused by a bacterial organism which attacks a great many different trees and plants, causing various types of abnormal growths. In some cases the crown of the trees or the roots develop large, more or less rounded, hard galls; in other cases the galls are more irregular in shape, and soft; in still others the infection results in a soft, flattened, callus growth, from which many fibrous roots develop, producing the effect commonly known as "hairy root."

Crown gall is not ranked as a necessarily fatal disease of fruit trees. It is known to vary in the degree of its injuriousness under different conditions. In Arizona many bearing deciduous fruit trees have been destroyed or rendered unprofitable by this disease and all of the best authorities are agreed that under all conditions nursery stock affected with it should be discarded and never planted. Crown gall affected trees are commercially worthless and all reputable nurserymen endeavor to avoid including diseased stock in filling their orders. Crown gall disease is prevalent in all parts of the country and is believed to exist in most deciduous fruit nurseries.

Under the provisions of the original inspection law in Arizona, our work was confined to insect pests, and we had no authority to prevent the delivery of trees or plants infected by plant diseases. Under the amended "Crop Pest law," however, action against diseased plants is authorized. The need for this is strikingly shown by a recently inspected shipment of nursery stock to Safford, Arizona, from a nursery in Portland, Oregon. This shipment included 3,000 apple trees, and the inspector's report showed that crown gall affected trees were found in every bundle of trees throughout the lot and that one bundle of ten trees included five infected specimens. Five examples sent to the writer's office showed the disease in a most pronounced and unmistakable form. The consignees did not need to be informed concerning the worthlessness of the diseased trees, and according to their estimate, one fifth of the entire lot of 3,000 trees were visibly infected.

The significance of this outrageously large proportion of worthless trees included by the shippers is indicated by the proportion of diseased trees normally present in honestly sorted nursery stock shipped into this State. It is admittedly practically impossible to prepare a large shipment of deciduous nursery stock and eliminate all trees visibly infected with crown gall, if the disease is present in the nursery. Nevertheless, the inspection of many carloads of deciduous fruit stock from reliable western nurseries has resulted in finding less than one tenth of one per cent of the trees visibly infected by this disease. A representative of a well known Oregon nursery recently called at the writer's office and upon being shown the five specimens of diseased trees from the Safford shipment, referred to above, stated that he would be willing to guarantee a customer against as many typical crown gall infected trees in an entire car lot. In a car lot of ten thousand trees, this would represent one twentieth of one per cent. At the rate the infection was found in the Safford shipment, however, there would be two thousand visibly infected trees in a car lot of ten thousand.

If we credit the shippers with having made an honest effort to separate out the worthless diseased trees before shipping the order, we are forced to conclude that the sample of their stock shipped to Safford is quite free from the disease as compared with the average stock in the nursery from which the stock was selected. We must also conclude from the sample sent to this State, that the incipient infection among the trees not visibly diseased is at least 200 times as abundant in proportion in shipments such as this, with 20 per cent visibly infected, as in shipments showing only the normal degree of infection, or less than one tenth of one per cent.

The Arizona law gives specific discretionary powers to the inspectors acting under the directions of the State Entomologist. If crown gall was not known to exist in the State, the writer would not hesitate to insist that shipments be absolutely free from visible crown gall infection, and to recommend to the Commission of Agriculture and Horticulture quarantine regulations which would restrict the danger of importing the disease. Since it already exists here, however, we can only prevent the unnecessary spread to uninfected soils and prevent losses to planters from planting and caring for visibly infected trees. From abundant experience it has been determined that an allowance of one per cent of stock visibly infected with crown gall in an imported shipment, is fully ten times as much as reliable nurserymen need as a margin against unavoidable oversights. On the other hand, it is of advantage to the fruit interests of this State to have the allowance placed as low as possible. Shippers will be less likely to make their selections from grossly infected lots of stock, the proportion of incipiently diseased stock will be, on the whole, greatly reduced, and incidentally Arizona customers will not be forced to pay the transportation charges on an unreasonable proportion of diseased trees.

In consideration of the facts above presented, with the desire to meet the needs of both the shippers and importers, the writer has, under date of January 31, 1913, issued the accompanying instructions to Arizona crop pest inspectors.

A. W. Morrill, State Entomologist.

INSPECTION ORDER NO. 3.

Crown Gall.

Since "crown gall" is of common occurrence in all parts of the country, occurring in practically all nurseries, particularly in the west, since this disease is already prevalent in Arizona, and since it is impossible by means of inspection to entirely prevent further introduction of the infection, *one per cent* is hereby established as the maximum degree of infection to be passed by Arizona crop pest inspectors. If more than one tree in a hundred of a kind (apple or peach, for instance), is plainly infected with crown gall, *all* of that kind will be rejected and not released. Such other kinds of trees or plants as may be in the same shipment, but do not show crown gall infection to exceed one per cent, will be released. Every tree or plant showing crown gall disease will be discarded. If the shipment, or any kind of plant or tree comprising the shipment, shows infection in excess of one per cent, samples, selected in the presence of the consignee or some other person, if possible, will be submitted to the office of the State Entomologist, and the remainder of the diseased stock held for advices from the owner as to option specified in section 15, crop pest law of 1912. If one per cent or less of the shipment, or any kind of plant or tree contained therein, is found to show crown gall infection, all diseased and suspected stock must be burned, as a condition of the issuance of the release for the balance of the stock.

For the protection of the consignee, trees that are "strongly suspected" of crown gall infection will be discarded at the time of inspection, but in figuring the percentage of trees infected when the amount is close to one per cent, none but well developed and characteristic infections will be counted. Roughened draft unions should not be counted as crown gall infections unless the development of "callus" at that point is excessive as illustrated in Bulletin 186 (Plate VIII, fig. 2) of the Bureau of Plant Industry, United States Department of Agriculture. Whenever a shipment of any kind of tree, vine or plant in a shipment shows well defined crown gall infection in excess of one per cent of the stock, such stock will not be reshipped or destroyed on account of crown gall infection until samples have been passed upon by the State Entomologist or Assistant State Entomologist.

A. W. Morrill, State Entomologist.

Phoenix, Arizona, January 31, 1913.

THE POTATO TUBER MOTH.

Suggestions to Potato Growers and Shippers.

The potato tuber moth is causing much anxiety in the states of Oregon and Washington, where the pest has not yet become established. All possible measures are being adopted to prevent further spread of the insect within and without California. In as much as

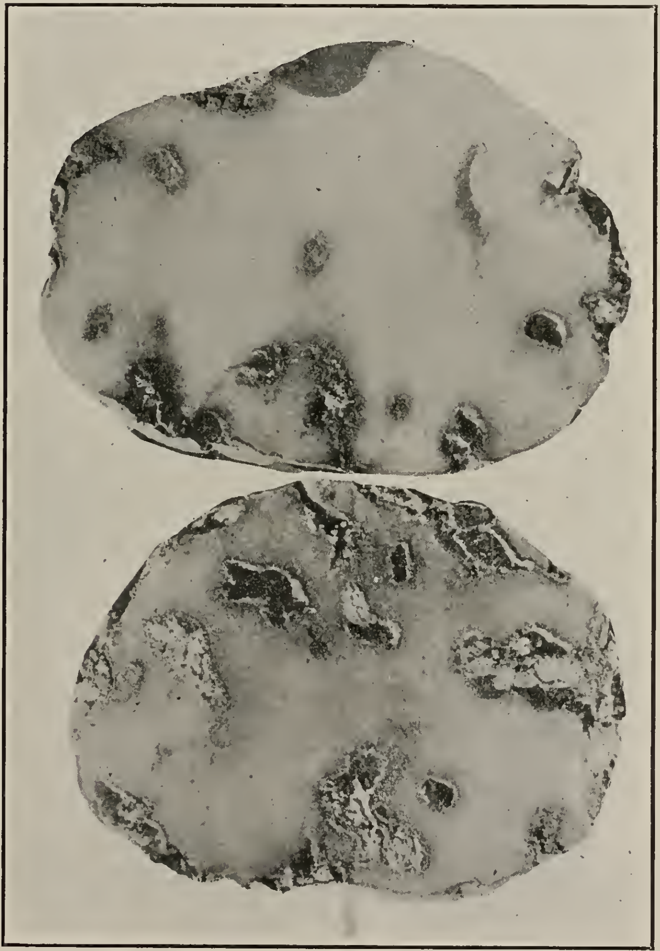

Fig. 365—Cross section of potato showing the work of the potato tuber moth.

spread is usually through the transportation of infested potatoes, all growers and shippers in the infested areas of this State should take every precaution to see that not a single infested potato is allowed to be shipped either to points within or without the State. It is feared that if our growers do not heed this, that it will not be long before some states take action to prevent the shipping of all California potatoes, which will mean a great loss to commercial potato growers.

For the protection of the potato growing industry of California, growers should procure seed potatoes from districts known to be entirely free from this pest. All seed should be thoroughly inspected just before planting to be sure that obscure infestations have not developed in storage.

It is sincerely hoped that all public horticultural officials, growers and shippers will work to the end that no infested potatoes be allowed to be shipped or planted.—E. O. Essig.

MONTHLY CROP REPORT—AUGUST.

These data are compiled by the secretary from monthly crop reports made by the county horticultural commissioners. Counties not included have not reported or the reports have come too late for press. Unless otherwise designated, percentages refer to last year's crop.

The report for August is brief because many of the crops have already been harvested. Conditions have remained unchanged in many counties. Reports from only sixteen counties have been received.

The conditions throughout the State have changed very little with respect to former estimates. The early frosts and continual hot weather have caused a shortage of most fruits and many have been damaged by sunburn. Good prices, however, are helping the growers to realize almost as much from their crops as during normal producing years.

Prospects for citrus fruits still remain about the same as reported in July, although there have been slight droppings in some of the interior districts in the Sacramento Valley.

INSECT NOTES.

The potato mealy bug, *Pseudococcus solani* (Ckll.) has been recently reported from San Joaquin County feeding upon the underground portions of the potato stalks. This insect also feeds upon the roots of nightshade, malva and pigweed and occurs in many parts of southern California. So far, however, it has not proven a pest.

The cottony cushion scale, *Icerya purchasi* var. *crawii* Ckll., has been sent in by Charles W. Weeks from Red Bluff, where it occurs on acacia. This light-bodied variety is usually much larger than the dark-bodied variety *maskelli*.

The confused flour beetle, *Tribolium confusum* Duv., has been reported in the granaries of Glenn County by Commissioner Carl Ley.

The orchard mite, *Epitrimerus pyri* Nal., has been reported from a number of localities in San Diego County, where it was first observed by Geo. P. Weldon.

The branch and twig borer, *Polycaon confertus* Lec. Commissioner Earl Morris of Santa Clara County reports the prune as a common host of this beetle in his county.

A dark blue blister beetle, *Cantharis stygica* Lec., has been reported as doing serious damage to lilac bushes in Modoc County by Commissioner O. C. McManus. Last year the same beetle did considerable damage to various ornamentals in Lassen County.

The jumper louse, *Lachnus juniperi* Del G., has been collected this month at Ventura, California, by S. H. Essig, who reports it working upon *Thuya* sp.

The squash bug, *Anasa tristis* De Geer, is reported as being present in many localities of Placer County, according to the report of Commissioner H. H. Bowman.

The hop aphis, *Phorodon humuli* Schrank. Mr. E. J. Branigan has returned from Towles, Placer County, where he collected approximately 3,000,000 *Hippodamia convergens* Guer. These are being used by County Commissioner Bloomer to combat the hop aphis.—E. J. Vosler.

The red-humped caterpillar, *Schizura concinna* S. & A., is doing minor damage to walnut trees in Yolo and Sacramento counties.—E. J. Vosler.

Herrn. F. Wichgraf, president of the Entomological Society of Berlin, to whom 30,000 live specimens of *Hippodamia convergens* Guer. were shipped by the State Commission of Horticulture some time ago, informs us that the shipment arrived in fine shape and he thinks that the beetles will be of much benefit in destroying the plant lice injurious to crops in Germany.—E. J. Vosler.

NOTES FROM THE COUNTY COMMISSIONERS.

By Geo. P. Weldon, Chief Deputy State Commissioner of Horticulture.

Butte County.

Mr. Earl Mills informs the office that the report in the last Monthly Bulletin that black scale occurs in commercial olive orchards in his county is wrong. He states that black scale does not occur in a single commercial orchard.

Humboldt County.

Geo. B. Weatherby is making arrangements for a series of meetings among the fruit growers early in September. Professor Van Normen, Dean of the University Farm School at Davis, and Geo. P. Weldon, Chief Deputy State Commissioner of Horticulture, are to address these gatherings.

Kern County.

K. S. Knowlton is conducting a vigorous campaign against the Russian thistle in his county.

Lake County.

Mr. G. A. Lyon, Horticultural Commissioner of Lake County, reports heavy planting of trees the past season. Bartlett pears are the main crop. They are netting the growers $32.00 per ton this season in spite of the fact that there are no railroad facilities and the nearest shipping point is 25 miles distant.

Mendocino County.

Mr. J. R. Banks, County Horticultural Commissioner of Mendocino County, has deputized Mr. E. M. Dutton, who graduated from the University of California, class of 1913, to help him in his work. The apple crop of the county is reported short for the season. Bartlett pears are fairly good and are bringing a good price.

Modoc County.

O. E. McManus, of Alturas, writes that pear blight is abundant in his county.

Stanislaus County.

A. L. Ruthford reports a milliped injuring lawns in the vicinity of Modesto.

Sutter County.

County Commissioner Stabler of Yuba City has issued a circular giving instructions for the use of the flour paste spray in controlling red spider on beans. This pest has been doing considerable damage of late in bean fields of Sutter County. Mr. Stabler's method of publishing and sending out specific information at the opportune time to those who are interested in some problem of insect control is to be commended.

QUARANTINE DIVISION.

COUNTY HORTICULTURAL COMMISSIONERS AND STATE QUARANTINE GUARDIANS.

By FREDERICK MASKEW, Chief Deputy Quarantine Officer, San Francisco, Cal.

The writing of the monthly record of the quarantine division has never, so far, furnished as much real pleasure to the author as the one herein set forth. The spontaneous, voluntary agreement of the county horticultural commissioners made at Sacramento, to henceforth work in harmony with the State Office has made possible the consummation of a long and ardently desired policy on the part of the executive head of the quarantine division. This department deals directly with county horticultural commissioners in so far as their functions as state quarantine guardians are concerned, or more directly speaking, in the matter of horticultural material arriving within the territory under their jurisdiction from outside the State boundary.

The establishment of a uniform policy and procedure in the matter of executing interstate quarantine regulations in each and all of the protected counties similar to those in vogue at all of the stations of the coast division will greatly increase the respect of future shippers for our insistent demand for clean nursery stock and create a general appreciation of the fact that the horticultural statutes of California were enacted with the intention that the same should be obeyed.

A full measure of recognition has been accorded to the coast division of the state quarantine service for their efforts and results, and it is the earnest desire of the writer that this shall extend to the entire interior division of the service. Every state quarantine guardian is a member of the quarantine division, and the complete working in unison of all concerned will cement together an impregnable wall of protection, through or over which no infected shipments can pass, and whatever good results to the State at large, the same will redound to the individual credit of each member of the entire division. What the central office at San Francisco needs to bring about this desired condition is prompt information of the receipt of imported horticultural products at interior points each month. In return for this collaboration, the central office stands ready to furnish advice—and assistance if needed—drawn from the great amount of material and information at its command concerning the insect pests and their host plants of the world at large, and the State regulations that govern their introduction.

REPORT FOR THE MONTH OF JULY, 1913.

By Frederick Maskew, Chief Deputy Quarantine Officer.

SAN FRANCISCO STATION.

Horticultural imports—

		Parcels.
Ships inspected	40	
Passed as free from pests		38,012
Fumigated		1,793
Destroyed or returned		306
Contraband destroyed		28
Total parcels horticultural products for the month		40,139

Horticultural exports—

	Parcels.
Inspected and certified	837

Pests Intercepted.

From Honolulu—
Diaspis bromeliæ and *Pseudococcus* sp. on pineapples.
Aphis sp., *Coccus hesperidum* and *Pseudococcus* sps., on betel leaves.
Cylas formicarius and *Cryptorhynchus batatæ* in sweet potatoes.
Hemichionaspis minor on tea plant cuttings.

From Japan—
Leucaspis japonica on maple.
Aphis sp. on pine.
Pulvinaria sp. on plant.

From Guatemala—
Caulophilus latinasus in avocado seeds.
Bruchus sp. in beans.

From Central America—
Chrysomphalus biformis on orchids.

From New York—
Pseudococcus sp. on begonia.

From Tahiti—
Lepidosaphes beckii on oranges.

LOS ANGELES STATION.

Horticultural imports—

		Parcels.
Ships inspected	22	
Passed as free from pests		32,080
Fumigated		165
Destroyed or returned		11
Contraband destroyed		--
Total parcels horticultural products for the month		32,256

Pests Intercepted.

From Algeria—
Parlatoria blanchardii and *Phœnicococcus marlatti* on date palms.

From Connecticut—
Pseudococcus sp. on gardenias.

From Florida—
Lepidosaphes beckii and *Melanose* on pomelo.

From Illinois—
Orthezia insignis on unidentified plant.

From Mexico—
Coccus hesperidum on palms.
Heilipus lauri in avocado seeds.

From New Jersey—
Chrysomphalus dictyospermi, *Coccus hesperidum*, *Diaspis boisduvalii*, *Eucalymnatus perforatus* and *Pseudococcus* sps. on orchids.
Coccus hesperidum and *Pseudococcus citri* on acacia.
Pseudococcus citri on dracena palm.
Pseudococcus citri on *Hibertia* sps.
Pseudococcus citri on *Ficus utilis*.

From Pennsylvania—
Aspidiotus hederæ on Kentia palms.

SAN DIEGO STATION.

Horticultural imports—

		Parcels.
Ships inspected	30	
Passed as free from pests		6,296
Fumigated		1
Destroyed or returned		4
Contraband destroyed		7
Total parcels horticultural products for the month		6,308

Pests Intercepted.

From Japan—
Pseudococcus sp. on dwarf pine.
Aspidiotus sp. on rose bush.

From Ohio—
Pseudococcus sp. on shipment of miscellaneous plants.

From Mexico—
Orthezia sp. on *Jasminum* sp.
Hemispherical scale and black scale on *Jasminum* sps.

SANTA BARBARA STATION.

Ships inspected	1

No horticultural imports.

EUREKA STATION.

Ships inspected	5

No horticultural imports.

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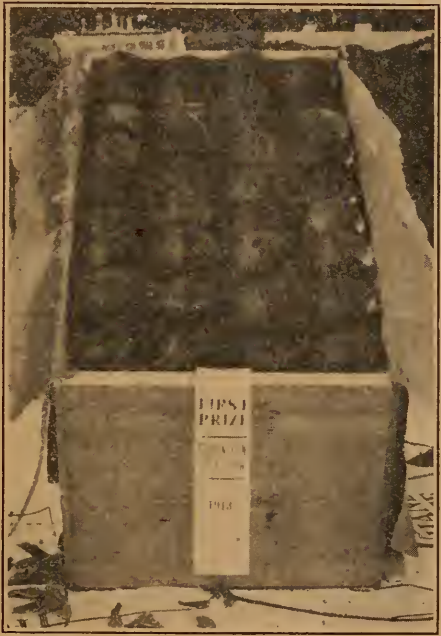
VOLUME II No. 10

THE MONTHLY BULLETIN



Prize winning box of Gravenstein apples at the recent Sebastopol Gravenstein Apple Show. (Photo by Geo. P. Weldon.)

OF

STATE COMMISSION OF HORTICULTURE

SACRAMENTO, CALIFORNIA OCTOBER, 1913

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STATE COMMISSION OF HORTICULTURE

October, 1913

THE MONTHLY BULLETIN

VOLUME II No. 10

DEVOTED TO THE DESCRIPTIONS, LIFE HABITS AND METHODS OF CONTROL OF INSECTS, FUNGOID DISEASES AND NOXIOUS WEEDS AND ANIMALS, ESPECIALLY IN THEIR RELATIONS TO AGRICULTURE AND HORTICULTURE.

EDITED BY THE ENTIRE FORCE OF THE COMMISSION UNDER THE FOLLOWING DIRECTORS:

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SACRAMENTO, CALIFORNIA
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BY

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State Commissioner of Horticulture

(And for many years a close student of all phases of this great industry)

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STATE COMMISSIONER OF HORTICULTURE

Sacramento, California.

THE SEBASTOPOL GRAVENSTEIN APPLE SHOW.

By Geo. P. Weldon, Chief Deputy State Commissioner of Horticulture.

Sebastopol has become famous, not only in California, but throughout the apple-growing sections of the United States, because of her annual Gravenstein show, thus furnishing a splendid illustration of what enterprise and united effort will do toward building up the reputation of a community.

The Gravenstein.

This one variety has been responsible for much of the fame that has come to the section of California adjacent to Sebastopol where it is grown, not necessarily because this particular variety of apple is the best that there is, but because it has been grown extensively. Instead of a great many varieties, we find this to be the one which is grown almost exclusively, and as a consequence such splendid shows as the one recently held are possible, and not only is this true, but it also follows that a good market is assured. The Sebastopol section is adapted to the growing of this splendid apple; there it seems to be in its element, and an intelligent community has taken advantage of this fact, uniting their efforts towards the production and perfection of this one variety.

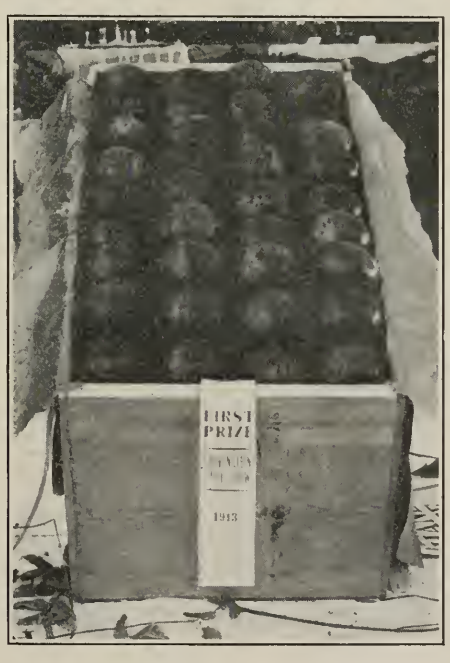

Fig. 366.—Prize winning box of Gravenstein apples, Sebastopol Gravenstein Apple Show. (Original.)

Other sections of California, and of other states, have specialized also, and we think of Watsonville in connection with her Yellow Newtown Pippins and Yellow Bellflowers; Hood River, Oregon, has been made famous by her Spitzenbergs, and so we might name a great many cases of success in the apple world due to specializing in the growing of certain well-adapted varieties.

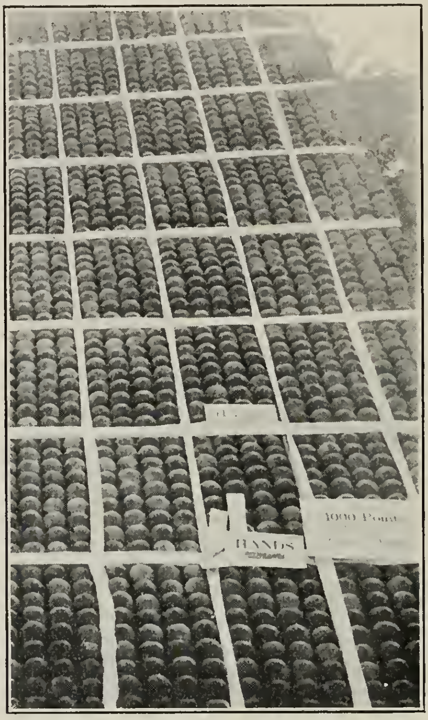

FIG. 367.—Prize winning Alexanders, Sebastopol Gravenstein Apple Show. (Original.)

Lesson to Other Sections.

Other sections may not be able to grow the Gravenstein, the Yellow Newtown, the Yellow Bellflower, or the Spitzenberg successfully, but there may be still other equally as good varieties that will grow to perfection. The time has passed when the orchardist can grow a miscellaneous lot of varieties, a little of this and a little of that, and succeed from a commercial standpoint. In the early days of orcharding in California, this was done, partly because it was not then known what varieties would do the best, and partly because an unlimited market was at the disposal of all. In this day of keen competition in the fruit business, it is necessary to produce the best and in sufficient quantity to be able to dispose of carload lots of one variety. Recently, the writer visited certain sections of the State where each man who grows apples is trying to succeed with a great many varieties, caring not what his neighbor may be growing. With the lesson of Sebastopol before us, is it not time for such people to get together, agree on some good variety or a few good varieties, and plant them to the exclusion of everything else? Not until this is done can it be hoped to compete with sections such as those already named.

Educational Value of the Show.

The thousands of visitors who went through the exhibit tent must surely have carried away with them something in the way of new ideas. Exhibit after exhibit of well selected Gravensteins; carefully prepared and expensive feature displays made from the same kind of apples, must have brought to them the significant fact that the Gravenstein made the show possible. To the orchardists, even those who had been successful from a financial standpoint, there were many lessons. It was said that never before has so good a pack been seen at the Sebastopol show. Fruit must be well cared for in the orchard, well selected and well packed, to receive a perfect score at the hands of competent judges. Such fruit was on exhibition this year, indicating that some had learned the lesson that worm-specked, scabby, poorly packed fruit, lacking in color and uniformity, would not score well and could never gain a premium in competition with well selected, well packed fruit free from blemishes, such as is shown in Figs. 366 and 367.

Lesson in Better Care of Orchards.

The effect of such a show relative to the general care of the orchard can scarcely be estimated. Pruning, cultivating, spraying, and thinning are all necessary for the best development of apples. Show fruit, such as was seen at Sebastopol, can only be grown when the proper attention has been given to some of these important phases of orchard management. A discount of 40 points for a wormy apple made it necessary for very careful selection of the fruit, in order that none of it might be found infested with the codling moth. While some may look upon such a discount as unjust, it is certainly valuable in that it teaches the lesson that wormy fruit is undesirable; that the buyer, when he goes through a box of extra fancy stock, does not want to find a single worm.. Codling moth can be controlled effectively by proper attention to spraying, and such being the case, there is little excuse for wormy fruit being exhibited. Greater uniformity and better color will result from proper pruning and thinning. Cultivation along with spraying should practically eliminate scab. All these things were no doubt brought to the mind of the orchardist who looked over the exhibit and who would make the most out of his fruit.

Sebastopol deserves to be congratulated upon the splendid showing made. From an advertising standpoint she has been eminently successful; the educational value can never be estimated, but it is safe to say that the future will profit greatly because of the quality of the exhibits and the care exercised in their display. From an æsthetic point of view there was much to charm. Fig. 368 gives some idea of the amount of work that was necessary to prepare the feature exhibits which were a credit to any community.

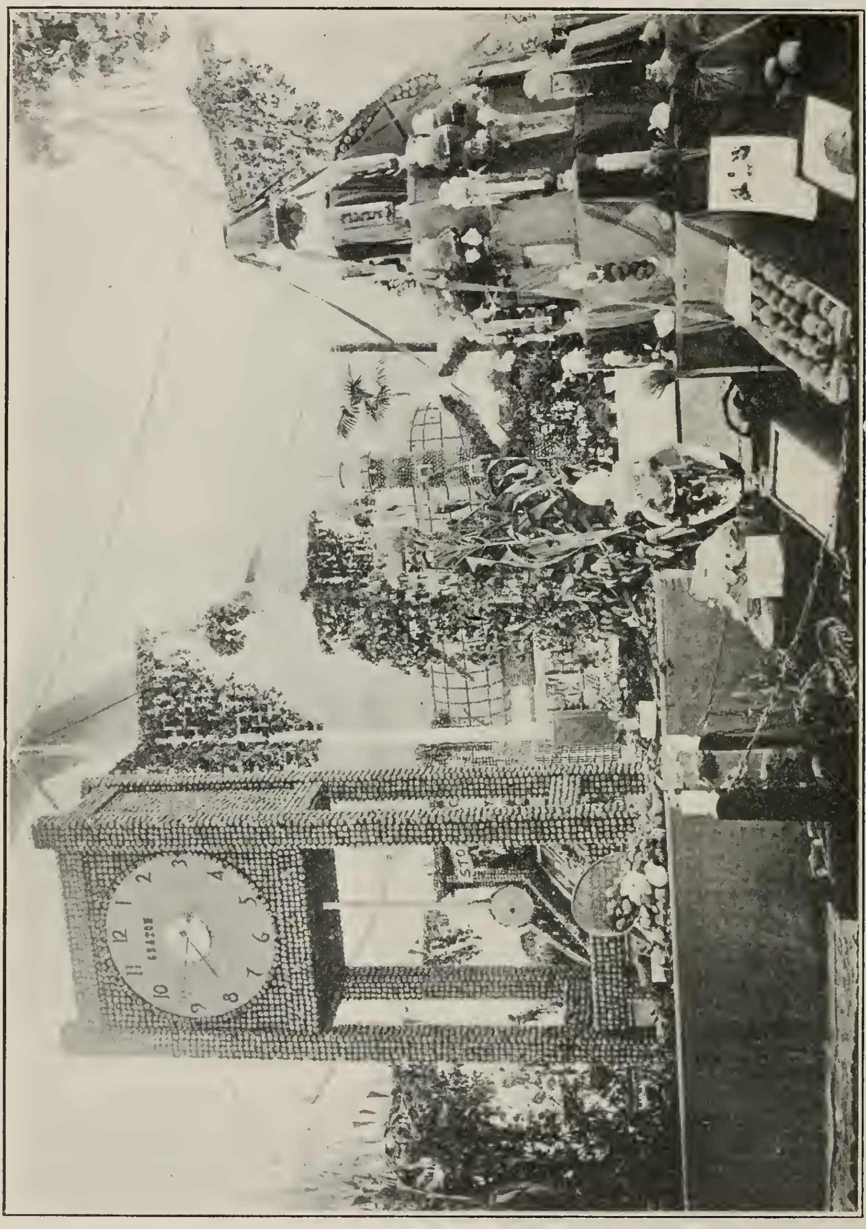

FIG. 368.—Some of the feature exhibits of the Sebastopol Gravenstein Apple Show. (Original.)

THE GUNWORM OF THE GRAPE.

(*Sciopteron regale* But.)

Order—Lepidoptera. Family—Sesiidæ.

By FREDERICK MASKEW, Chief Deputy Quarantine Officer.

The phase of quarantine work that deals with the personal belongings of the globe-trotting passengers who arrive at the port of San Francisco is a never ending drama, replete with side-lights on the various whims, fancies and idiosyncrasies of these peregrinators, as expressed by the articles that have attracted both their interest and coin in some of the ports they have visited, and to which, as yet uncloyed by possession they attach the greatest of value. Strictly within his own domain, the quarantine officer's sense of uniqueness or oddity is dulled by familiarity and his acquaintance with the tricks of Oriental gardeners. His chief interest is in the insects that have usually escaped the attention of the owner of the material. With the quarantine officer all insects are—at least potential—rascals. The beauty and grace of their structure or covering makes no impression; even as Dickens, in his own inimitable way, depicted the dominating influence an occupation has upon the point of view, when he described the public hangman as unable to see any feature in a gathering of celebrities other than the caliper of their necks. So with the quarantine officer: even a strange coccinellid found on an importation, brings a frown of suspicion. The many virtues possessed by the numerous species of this family are overshadowed by the vices of one black sheep. *Epilachna* obliterates *Novius* for the time being, and on general principles the specimen, together with its host, is taken in and kept in, until its general behavior can be vouched for.

In this particular instance, a passenger, a man of much wealth and abundant leisure, was bringing from Yokahama a number of song birds to enrich the collection in his large aviary at Cleveland, Ohio. Even the most hardened of quarantine inspectors had no objections to this, but, herein lies the tale. He had brought also a sack full of small cuttings of some species of vine—''just a little bird food''—was the casual way he indicated what the sack contained, and it was patent to all who heard, that he was innocent or ignorant of any potential danger in the material. However, seeing that the contents of the sack were something that had grown out of the soil, it must of a necessity be carefully examined. Look at Fig. 369, an actual photograph of a portion of the material. It did not require a trained inspector to see that these twigs were abnormal; the swellings would indicate the presence of some thrifty tenant; a touch of the knife revealed the true condition; a yellow, plump, greasy larvæ of a sesiid borer that had grown fat on the living tissues and vital forces of these vines, and which in turn was destined to fatten this lot of songsters in transit to Cleveland. The future of California's vineyards immediately took precedence of ornithological menus or melodies; the possibility of an infested twig or two being dropped while the material was in transit through the State, was considered of greater importance than a hungry songster, so the entire lot was confiscated, much to the chagrin of the owner, who did not need

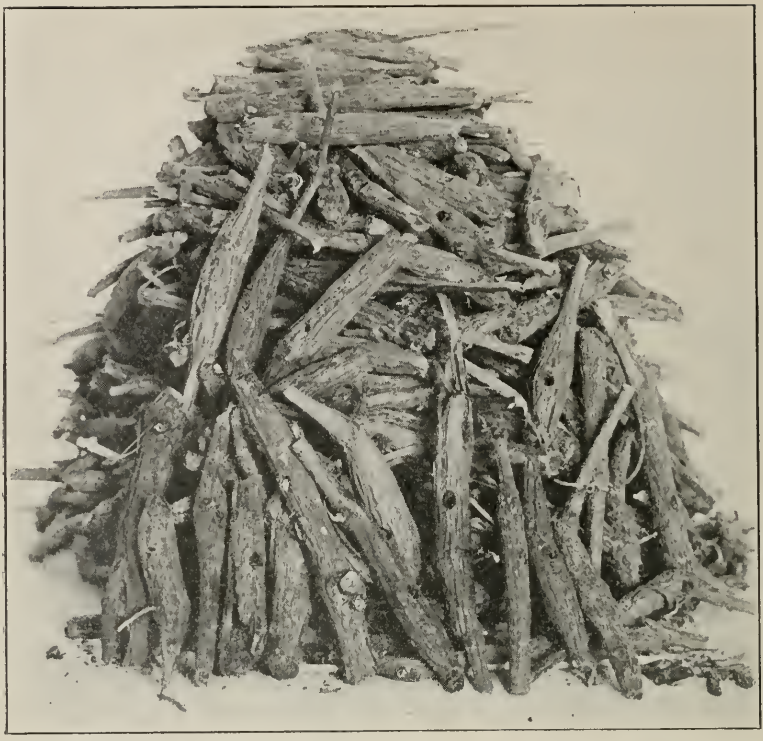

FIG. 369.—Work of the gunworm of the grape on material taken in quarantine by the author. The holes and swellings are the result of the insect's work. (Photo by Chatterley.)

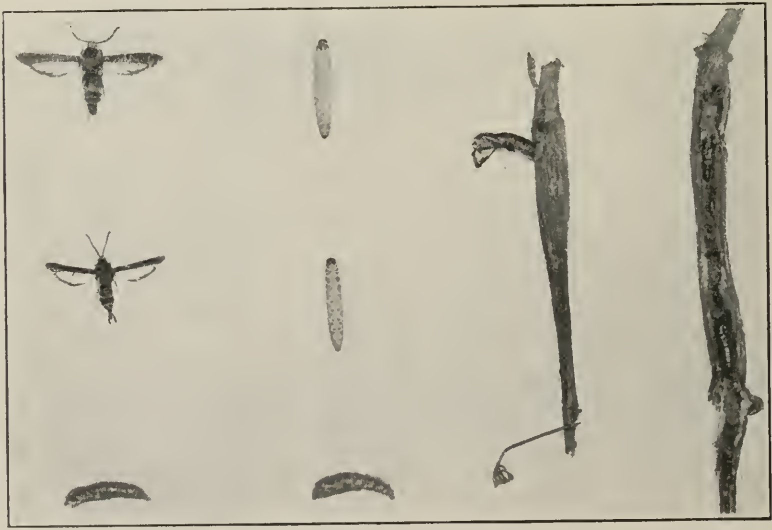

FIG. 370.—The gunworm of the grape, *Sciopteron regale* But., showing work on vine, larvæ (in middle), pupæ (at bottom), and adult moths. Reduced about one half. (Photo by Chatterley.)

the present annual returns from some vineyard to enable him to meet the ever increasing cost of living.

From this material was taken the different samples of the destructive work illustrated in this article, together with the specimens of several life stages of the insect (Fig. 370), which have been described by E. O. Essig, as follows:

Larvæ.—The matured larvæ vary from three fourths to one inch in length and from three tenths to two fifths of an inch in diameter.

The color is yellow with feet and head dark rich brown and the prothoracic plate light brown. The spiracles are also brown. There are two distinct rows of deep yellow spine areas on the dorsum—four areas to each abdominal segment; a row on each side of the spiracles; a row in line with the spiracles and which do not appear to bear spines, and a row just above the legs on the sides. Nearly all of these areas bear a single slightly curved brown spine, though on the dorsum of the pro- and mesothorax there are usually two spines to an area. Similar spines also occur around the bases of the prolegs and on the head, prothorax and tip of the posterior end.

There are three pairs of true legs, four pairs of prolegs, just back of the middle, and one pair of prolegs at the extreme posterior end. The tips of these legs are brown.

Pupæ.—The pupæ or chrysalids are rich amber brown throughout in color and average about three fourths of an inch in length.

Adult.—The average length of the adult moth is three fourths of an inch, the wing expanse being about one and one half inches. The general color is orange and black with a hue of iridescent purple. The head is orange with the bases of the palpi and eyes black—the tips of the palpi being orange. The antennæ are dark iridescent purple, becoming somewhat brownish towards the tips. The thorax is black with orange spots at the bases of the wings, two similar spots on the sides of the prothorax just behind the head, and an orange band across the dorsum, and two orange spots on each side of the metathorax at the bases of the hind wings. The legs are black with light orange markings on the coxæ and other joints. The forewings are entirely opaque, covered with brown and orange scales with a pinkish iridescense. The hind wings are transparent with brownish-yellow borders. They are also iridescent. The abdomen is velvety black, appearing purple under certain side lights. There are several inconspicuous and two prominent orange bands; the widest being near the middle and the second widest being near the tip. The tuft at the tip is black.

In Japan this insect is known as the "Budoo-no-teppoo-mushi," meaning "gunworm of the grape." The larvæ bore into the canes of the grapevines and are very destructive to viticulture in that country.

MORE IRRIGATION.

By A. J. Cook, State Commissioner of Horticulture.

One of the finest and most profitable deciduous fruit orchards of California is situated close beside the banks of the Sacramento River. For years this grove received no water other than that which came from the annual rainfall; even then the profits were large. A few years ago a centrifugal pump was installed, by aid of which abundant water was drawn over the levee from the river. Since that time, just prior to the picking season, the orchard is thoroughly irrigated. The profits since have increased from one third to one half. Two years ago the receipts from the seventy acres exceeded $40,000. Last year nearly two thirds as much profit was received. This year the returns have exceeded those of any previous year. The owner feels sure that the present crop is much improved in quantity and quality, while probably the greatest advantage comes from added vigor and stimulus which secures more and finer fruit buds. This experience, as given above, has a lesson for every fruit grower of the State.

More Water Available.

Of course such streams as the Sacramento, American, Feather, San Joaquin, etc., are all too restricted in their distribution, yet these in their location are not utilized to anything like what the best success of the farmers demand, but there is an almost inexhaustible supply in the underground reservoirs in nearly all parts of the State. Wells sunk into these sub-earth gravels are often artesian and even, when not flowing, with our cheap electric energy, pumping is not so expensive as to be prohibitive, but will generally pay a large per cent on its cost. I believe that soon the increase in profit in very many of our fields and orchards, through a more generous supply of water will equal those referred to above.

This present season in the county of Sacramento, there has been an excessive drop of oranges in some of the groves. It is true that some dropping of fruit is to be expected and is even desirable. It is nature's way of thinning the fruit, and lessening the overstrain of the trees. Sometimes this thinning is over done and considerable loss occurs. In parts of this and other northern citrus counties, this dropping is excessive in some of the orchards this season and loss will result. There is, however, compensation, as the trees will profit by the release from full or over production and will be in better condition for service next year. The evident cause for this overdrop this present season, in some cases at least, is lack of water. The curled leaves prove this beyond conjecture. Indeed, some of the orchards are thirsty, and possibly chronically so. It would be the height of wisdom to plan at once for more water. In usual seasons the water is all too limited in amount; in seasons of extreme heat, like the present, any lack of moisture is very likely to become serious. Great heat with plants, as with animals, is not serious—with plants is really advantageous—if abundance of water is in the sap or blood; but in its absence, great danger, often fatality, results.

The obvious conclusion from the above fact is, provide for and use more water. In case a perennial stream is near by, utilize this advantage to the utmost; in its absence, study your locality to learn if you have artesian water, or water in the underground reservoirs that may be pumped, and prepare as soon as possible to secure for all your crops sufficient moisture for the best production at all times, and especially during seasons of excessive heat.

In the few cases where extra water is impossible, we may still hope with our favorable soil and climate and the best cultivation, to secure ample crops of grain and of some deciduous fruits.

THE WESTERN TWIG BORER.

(*Amphicerus punctipennis* Lec.)

Order—Coleoptera. Family—Bostrychidæ.

By E. O. Essig, Secretary State Commission of Horticulture.

Since publishing the article on the branch and twig borer, *Polycaon confertus* Lec., in The Monthly Bulletin, Vol. II, pp. 587-589, July, 1913, the writer has received twigs of apricot trees showing similar but more severe attacks of an insect with inquiries as to the cause. In this instance, the burrows were much longer than those made by the branch and twig borer, and the attacks much more damaging to the twigs. Specimens of the beetle causing the injuries were taken from the burrows and sent to Mr. Charles Fuchs of the California Academy of Sciences, who determined it as *Amphicerus punctipennis* Lec.

It is the aim of this article to give simply the data at hand, in order that others may recognize the insect and send it to this office with all data relative to it, in order that we may make a more thorough study of the life history, distribution, food plants, destructiveness, and control for future publication.

Work.

The work of this beetle greatly resembles that of the branch and twig borer, and may often be mistaken for it. The burrows are usually made at the axils of a bud or in a fork (Fig. 372), but this is by no means as common a characteristic as with the former, as is shown in Fig. 371. Here the burrows are made irrespective of any particular place on the twigs. The burrows vary from one to three inches in length and are about one eighth of an inch in diameter. The smaller twigs are either so weakened by the short burrows that their weight causes them to break, or they are completely hollowed out by the long burrows so that they simply hang by the bark and dangle from the tree. The tunnels are usually partially filled with the frass made by the beetles, and the entrances are ofen sealed with a large globule of gum which has been produced by the injury. (Fig. 372.)

Apparently the beetles bore into the twigs for food and protection and not to deposit eggs.

Damage.

From what is known of this species, it appears to prefer dead or dying wood to breed in. D. W. Coquillett first bred it from dead fig twigs and later from dry canes of grape. Dr. Edwin C. Van Dyke has

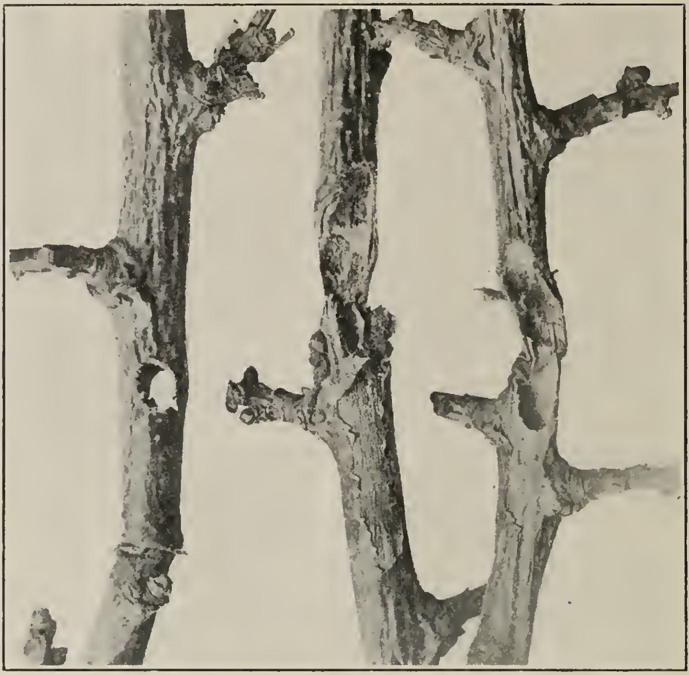

FIG. 371.—The work of the Western twig borer, *Amphicerus punctipennis* Lec., on living twigs of apricot tree. Twice enlarged. (Original.)

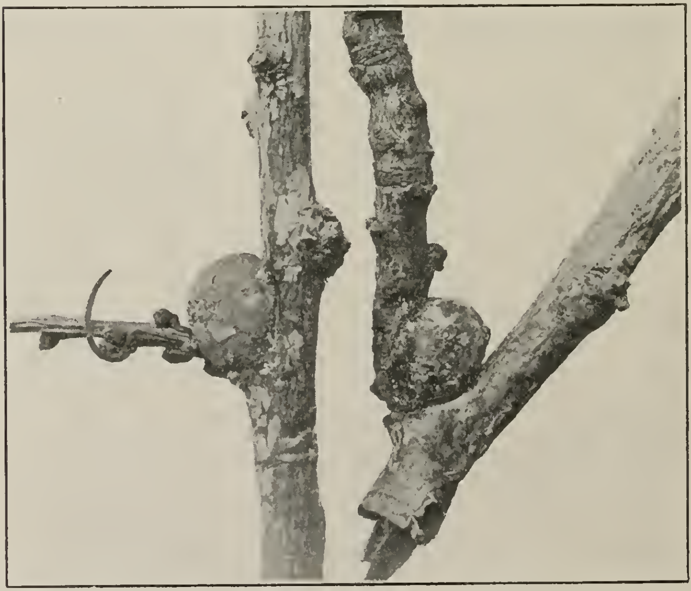

FIG. 372.—Gum globules formed over the entrances of burrows made by the Western twig borer, *Amphicerus punctipennis* Lec. Twice enlarged. (Original.)

bred the beetles from mesquit cord wood and believes that in all probability they would attack living trees if in an unhealthy condition. He further states that "there is no doubt, however, that they could do a great deal of harm to woodwork in the Southwest, particularly if the wood was mesquit, acacia or any wood that was to their liking."[1] In the early part of September Mr. B. R. Jones, Deputy County Horticultural Commissioner of Los Angeles County, sent in twigs of apricot trees which were seriously injured by these beetles and which contained four living adult beetles at work in the burrows. He stated that many burrows were made at the crotches of the trees and were filled with gum. He does not state that the affected trees are in poor condition, and the writer infers that they were in a normal, healthy state. Mr. Jones further states that should the attacks become common in an orchard, much damage would be done.

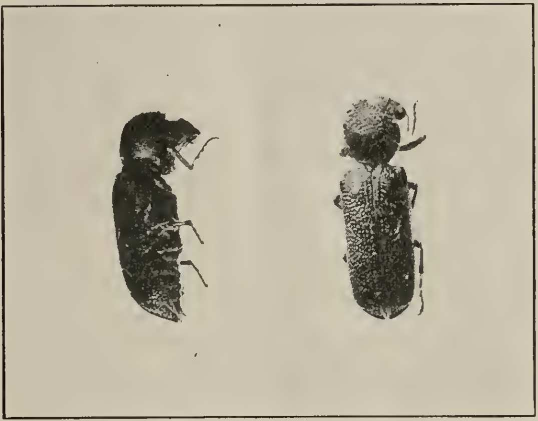

FIG. 373.—Adult female of the Western twig borer, *Amphicerus punctipennis* Lec. Dorsal and side views. Twice enlarged. (Original.)

Slight attacks of the beetle are reported by Mr. Geo. P. Weldon on pears in Humboldt and San Joaquin counties.

From all the data at hand, it does not appear that the attacks of this beetle are either serious or common. In the view of ascertaining these points, it is sincerely hoped that all occurrences and attacks will be reported to this office.

Appearance and Life History.

The adult beetles (Fig. 373) are dark brown, with feet and other portions of the body clothed with fine yellowish-brown hairs. The head is held at right angles to, and directly beneath the prothorax. The front of the prothorax is covered with many distinct tooth-like projections, which make this beetle easily distinguishable from the branch and twig borer. The wing covers are coarsely punctured and consequently very rough.

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[1] In letter dated Berkeley, Cal., Sept. 26, 1913.

This beetle differs from the Eastern apple twig borer (*Amphicerus bicaudatus* Say) in being larger.

Regarding the life history, Dr. Edwin C. Van Dyke, Department of Entomology, University of California, under date of September 26, 1913, writes: "It breeds normally in mesquit and probably some other desert trees. I used to breed it from mesquit cord wood, along with a larger species, *A. fortis,* and have received it from the more desert parts of Los Angeles County and Imperial County and so forth. It ranges, I think, throughout the desert southwest, running well into Mexico. *A. fortis* extends farther south into South America and even into the Galapagos Islands. I do not know of either species attacking living trees, though can believe that they would if the trees were diseased or dying, or if they had dead limbs still attached in which they could get a start."

Distribution.

The distribution of this beetle is apparently quite wide. It was first reported from Los Angeles County, October 4, 1891, by D. W. Coquillett.[2] Specimens were received from the same place in September, 1913, from Mr. B. R. Jones. Mr. Geo. P. Weldon has reported the work of this beetle at Dyerville, Humboldt County, and Stockton, San Joaquin County. Prof. H. C. Fall[3] gives the following localities: Riverside, Riverside County; Redlands, San Bernardino County; Pomona and Long Beach, Los Angeles County. Dr. Edwin C. Van Dyke reports it as occuring in the Southwest, especially mentioning Los Angeles and Imperial counties.

Food Plants.

Dead or dying wood seems to be the preferred food of this insect and allied species. Dr. Van Dyke gives the mesquit or algaroba [*Prosopis juliflora* (Schwartz) DC.] a desert plant common in the southwestern part of the United States as the normal food plant. Mr. Weldon reports pear as a host. Coquillett bred adults from dead branches of a fig tree and from the dry canes of a grapevine. The apricot is also a host, having been sent in by Mr. Jones of Los Angeles. Mr. Leroy Childs reports this insect working very extensively in dry orange wood at Redlands, Cal.

Control.

With the present fund of knowledge, the only control measures to suggest are:

1. Destroy breeding places if possible.
2. If present in an orchard, eliminate unhealthy or dead trees.
3. Keep trees in good growing vigor. They are less liable to become infested.
4. Prune out and burn all dead wood.

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[2] Insect Life, IV, p. 261, 1892.

[3] Coleoptera of Southern California, Cal. Acad. Sciences, VIII, p. 134, 1901.

AN IMPROVEMENT IN THE SETTING OF WAYSIDE TREES.

By A. L. Bancroft, Oakland, Cal.

Because trees have been set in stiff, exact rows along the waysides for ages, the possibility of there being any different and better way is apparently never even thought of.

Consider nature's way of grouping her trees and plants: there are no straight lines and no uniform and exact spaces between growing things of her setting, and she attains far better and more artistic results in her work than the man with the straight-edge and measuring line, and there is no end to her ever-changing combinations and artistic effects. The "English garden," with its stiff straight lines, is an abomination. The best to be secured is to follow along nature's lines, but adopting them to the varying conditions of the waysides.

In place of rows set the trees in clumps, as a rule of but a single variety in a clump. Let the clumps vary in size and natural groupings to fit the place, from three to thirty in a bunch; the distance apart of the trees and the number in a clump to depend upon the size and growth, habit of the tree and the distance between the clumps to depend upon the lay of the land, the soil, moisture, exposure, and other conditions.

The grouping of the trees should be the work of landscape artists, the best available. Their work would add much to the beauties of the landscape that took in such roads. Some clumps might extend two or three trees deep into the roadway, and, with the consent and co-operation of the landowner, some might also project back into the fields. Others, like the tall straight lombardy poplar and *Eucalyptus globulous,* would be effective in straight strings of about five in a line. The setting of the stakes for the clumps and for each tree in the clump should be the result of intelligent, artistic consideration given to each particular group. The spaces between clumps should be, probably, from fifty to two hundred feet. By this way of treating the waysides much better results can be obtained. The view of the road from a distance would be vastly more attractive, and the view from the roads would be much more enjoyable than to have it alternate every second or two by trees cutting off the view.

The roads would have more sun to dry up the summer as well as the winter rains, which would be an economic feature of importance enough to be taken into account and there would be numerous shady places under which to alight and enjoy the vistas.

Much more might be said upon this subject, but this is enough to show that this way would be a great improvement.

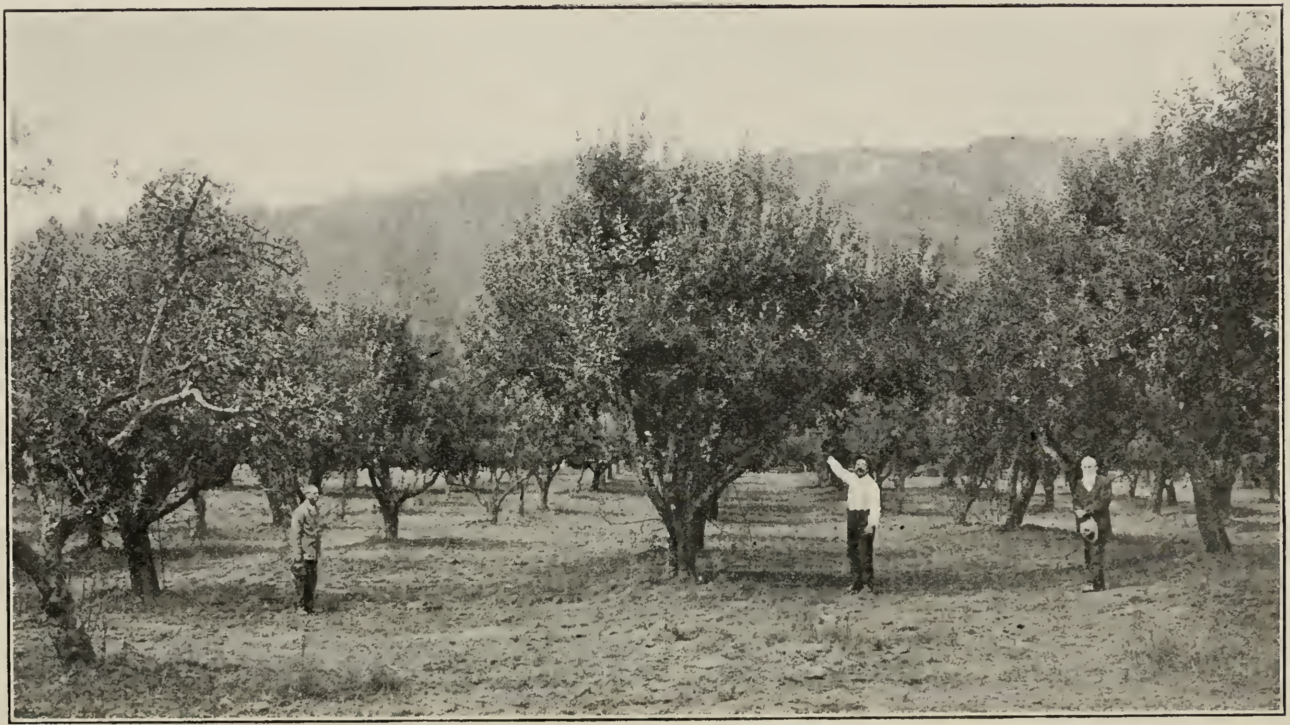

FIG. 374.—Madera County apple orchard in mountains near Nipinnawasee, said to be 50 years old. Note the almost perfect stand of trees. (Original.)

HORTICULTURAL NOTES FROM MADERA COUNTY.

By GEO. P. WELDON, Chief Deputy State Commissioner of Horticulture.

In company with Mr. Geo. Marchbank, County Horticultural Commissioner of Madera County, several days were spent investigating the horticultural interests of the mountainous section adjacent to the towns of Raymond, Oakhurst, Coarse Gold, Nipinnawasee and Miami.

While orcharding is not generally followed as a profession throughout this locality, the writer was impressed with the great possibilities for future development. At present, transportation facilities are such as to discourage anyone from going in extensively for growing fruit. The building of a railroad into this section would undoubtedly add a tremendous impetus to the industry; until such a road is built there is no way for the fruit to reach the market, except that it is hauled by team or auto truck a distance of 30 miles or more. The auto truck has already made its way into many not easily accessible parts of the mountains and may eventually solve the transportation problem to a large extent.

Apple Growing in Madera County.

The apple is the principal fruit grown in the mountains. A considerable acreage has been planted to this fruit in the past. At present many orchards are receiving very little attention because of the distance from market and the competition that must be met, with the growers who have the advantage of a railroad. Even with very little or no care in the way of cultivation, pruning, spraying, etc., a great many of the trees look well and are loaded down with clean, well-sized apples. Fig. 374 is from a picture taken of an apple orchard which is said to be 50 years old. The stock has been allowed to run in this orchard, and of late years it has received little attention; nevertheless, there is still almost a perfect stand which attests to the suitability of the soil and climate for growing trees.

Varieties.

The following varieties were found to be doing well in one or more of the orchards visited: Yellow Newtown Pippin, Yellow Bellflower, White Winter Pearmain, Delicious, Winesap, Staymen Winesap, Ortley, Rhode Island Greening, Arkansas Black, Mammoth Black Twig, Nero, Spitzenberg, Black Ben Davis, Ben Davis, Maiden Blush, as well as many others of lesser importance.

Particular mention should be made of the Delicious variety, some excellent specimens of which were seen in Mr. Frank Femmons' orchard. Fig. 375 is a picture of one of these trees. Mr. Femmons, the pioneer apple man of the section, who has always had faith in the future of the fruit industry, and who possesses a thorough knowledge of the apple, is standing in the foreground. The tree is about 18 years old and is loaded down with fine fruit, as are all the rest of the trees of this variety in the orchard.

The Staymen Winesap is also doing remarkably well and a number of trees of the Nero variety are loaded to the ground.

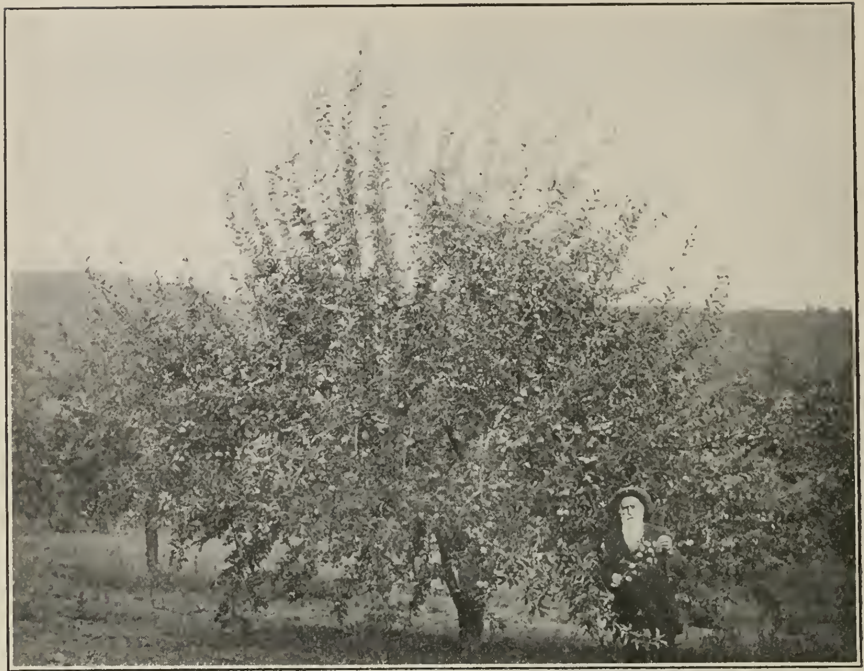

FIG. 375.—Well loaded Delicious apple tree in orchard set out by Mr. Frank Femmons, near Sugar Pine. (Original.)

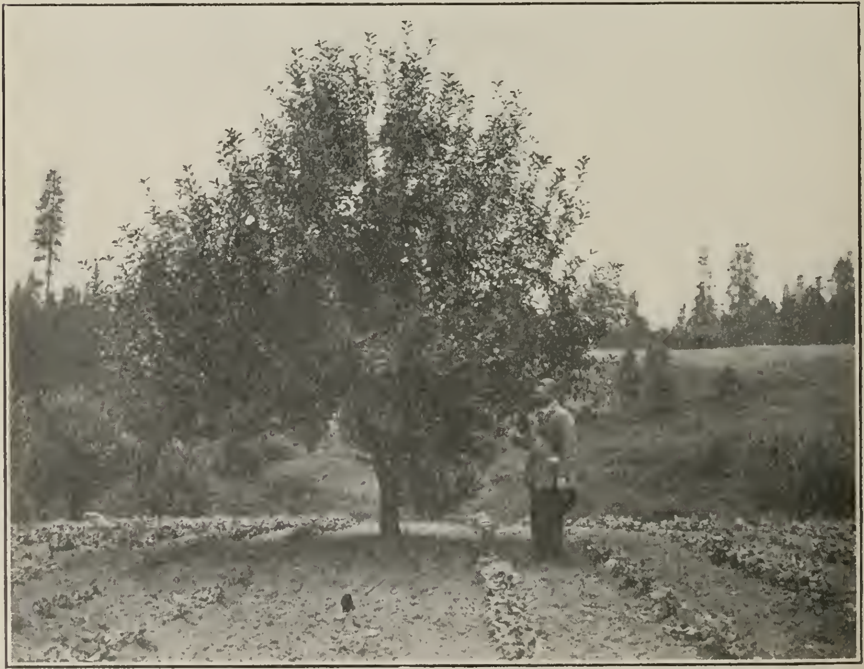

FIG. 376.—White Winter Pearmain apple tree growing at an altitude of approximately 5,000 feet, near Sugar Pine. (Original.)

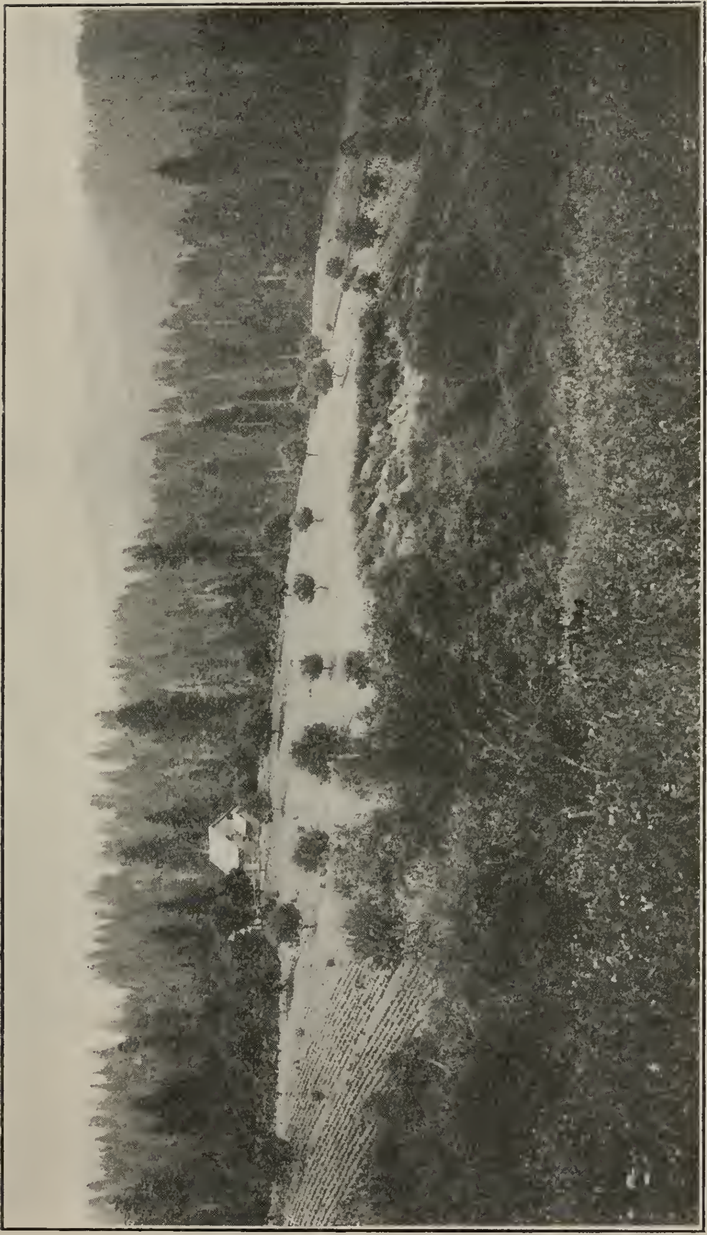

FIG. 377.—Orchard of Major Darnold near Sugar Pine at an altitude of about 5,000 feet. (Original.)

The White Winter Pearmain seems to have been quite a general favorite for planting in this locality. It pleased me to see this variety doing so well, as it certainly possesses much merit, and but for its color, would be one of our greatest sellers. A tree of this variety is shown in Fig. 376, growing at an altitude of between 4,000 and 5,000 feet. It has on it a good crop of fruit this season; this is also true of other trees of the same variety in the orchard. Fig. 377 gives a good idea of the character of the country where the orchard is growing.

Small Acreage Best.

At present it would probably not be policy to plant apples extensively in the mountains of Madera County (and what is said of Madera will apply to some of the other mountainous counties as well), but the fact that the soil and climate are well adapted to the growing of this, one of the finest of all fruits, indicates that there are great possibilities for success with small tracts at least, of good varieties, well cared for. Some have planted too extensively and have failed, partly because of poor varieties, but principally because of distance from market. At the present time there should be no trouble about picking out suitable varieties, provided the prospective planter will take the pains to investigate and find out which have done the best. It is doubtful, however, that a large acreage of the best varieties could be made to pay at the present time. On the other hand, a small tract, not to exceed 5 acres, would not necessitate a heavy expense in caring for it, and should be made to pay good interest on the investment, even though the distance from a railroad point is great.

Only Good Fruit Pays.

The growing of the very best quality and grade of any variety should be the ambition of one starting in the business. To accomplish this end the orchard should be properly pruned, tilled, fertilized, sprayed, etc. Fig. 378 is a good illustration of the extreme neglect of some of the orchards seen. The tall tree was estimated to be 35 feet high. The tree alongside is about the desirable height. Careful annual pruning would overcome this fault, and the fruit, instead of being small, would be of good size; the tree instead of breaking down under a load, if properly pruned, would hold it up well. Not only is pruning neglected in these orchards, but also cultivation, fertilization, and spraying. No orchard will care for itself, and unless these different phases of management are properly conducted, there can be little chance for good fruit, which, after all, is the only kind that it pays to raise.

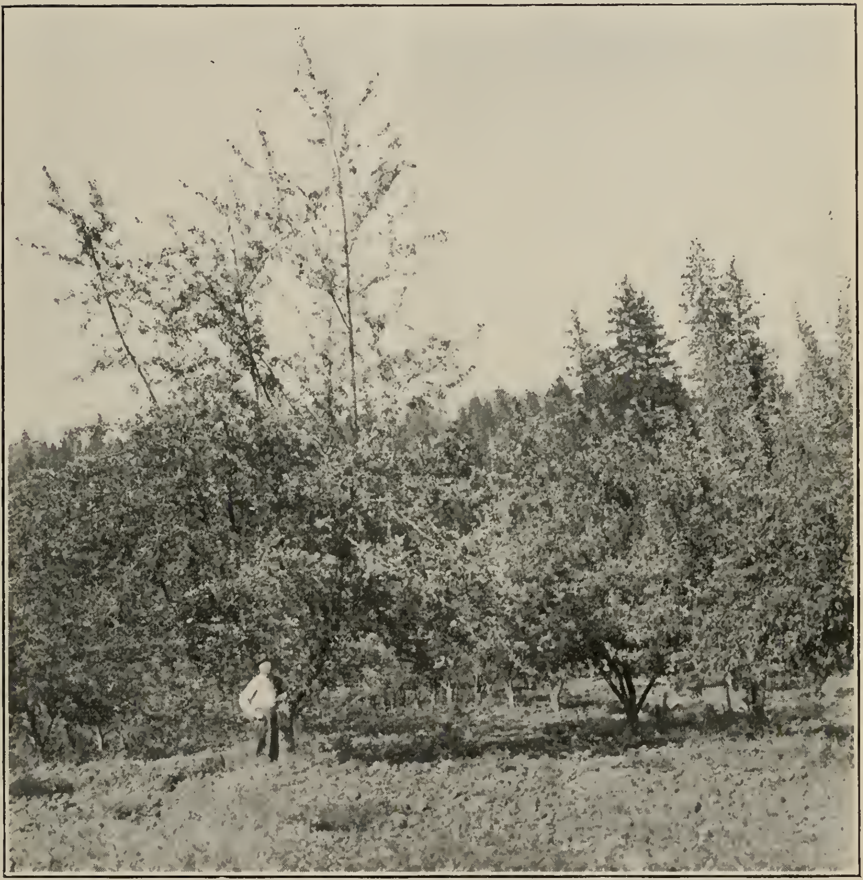

FIG. 378.—Apple trees showing extreme neglect of pruning. (Original.)

GENERAL NOTES.

THE SEBASTOPOL GRAVENSTEIN APPLE SHOW.

As chairman of the awarding committee at the Sebastopol Exposition, acting with Messrs. Henry C. Peckham of Watsonville, J. A. Evereth, San Francisco, and George P. Weldon, Chief Deputy State Horticultural Commissioner, I am pleased to report a wondrous display of Gravenstein apples. The Alexanders were also very fine. There was a substantial improvement over the exhibit of last year, good and creditable as that was.

In judging, forty demerits were given for each wormy fruit; eight for any show of scab, one for absence of stem, and one for any show of dry rot. Other demerits were given for lack of color, inferiority of size, lack of uniformity, etc. Last year the demerits generally reached nine hundred, more or less in a single collection, and nearly always reached to the hundreds. This year two exhibits, both by ladies, received a perfect score. Few had off counts reaching three figures, while most ran less than thirty. In large exhibits, every apple in three boxes, taken at random, were carefully inspected; in those of less magnitude, two boxes were thus examined, while one box was inspected in each exhibit. The perfection of this fruit was certainly phenomenal. Mr. Peckham, who has had long experience in growing, exhibiting and judging fruit, said he had never seen a finer collection of apples at any exhibition. He doubted if it could ever be surpassed.

The evident progress in developing excellence of fruit in grading and packing are proof positive that such exhibitions are richly worth all that they cost in time, labor and expense.

The feature exhibits were also remarkable for the ingenuity displayed in their conception, and also for their attractiveness. No wonder that the attendance was surprisingly large. While such fruit shows are commendable for their pleasure giving, they are at the same time very educatory. They will surely lead to a perfect pack, and will aid much to foster standardization.

In autoing through Sonoma County, we observed everywhere excellent cultivation of the orchard. The great reputation that this section has gained for its superior fruit, is, we believe, to a large extent indebted to these annual apple exhibits. The matter of thinning and spraying must certainly receive close attention, else the fruit exhibited at this apple show would never present such remarkable perfection.—A. J. Cook.

EFFECTS OF HOT WEATHER ON LEMON TREES SPRAYED WITH LIME-SULPHUR.

An interesting development was noticed in the fact that lemon trees sprayed with both Rex and Ortho lime-sulphur solutions for a period of ten days before the excessive heat, were very seriously burned. Quite a percentage of the fruit on the southwest corner of the trees was completely ruined. I have never seen the effects of spray injury followed by heat extend back over so long a period.—R. S. Vaile.

TENTATIVE PROGRAM OF THE FORTY-THIRD CALIFORNIA STATE FRUIT GROWERS' CONVENTION.

San Jose, Cal., Dec. 2, 3, 4, 1913.

1. Soils—3 lectures; Dr. C. B. Lipman, University of California, Berkeley, California.
2. General Comments on the Citrus Industry—Dr. H. J. Webber, Citrus Experiment Station, Riverside, California.
3. Should Growers Breed the Crops they Grow—Dr. H. J. Webber.
4. The Peach and its Culture—C. C. Collins, Dinuba, California.
5. State and Federal Quarantine—Frederick Maskew, Chief Deputy Quarantine Officer, San Francisco.
6. Unfermented Fruit Juices—Karl J. Stackland, Cave, Oregon.
7. Notes and Records of County Horticultural Commissioner, R. S. Vaile, County Horticultural Commissioner, Ventura County, Santa Paula, California.
8. Thinning Deciduous Fruits—Geo. P. Weldon, Chief Deputy Commissioner of Horticulture, Sacramento, California.
9. Standardization of Fruits—F. B. McKevitt, Sacramento, California.
10. Frost Protection—C. C. Teague, Manager Limoneira Ranch, Santa Paula, California.
11. Irrigation—Willis Jones, Claremont, Cal.
12. Alfalfa—A. J. Cook, State Commissioner of Horticulture, Sacramento, California.
13. Importance of Red Spider Control—H. P. Stabler, County Horticultural Commissioner, Yuba City, Sutter County, California.
14. Fungi—H. S. Fawcett, Assistant Professor of Pathology, Citrus Experiment Station, Whittier, California.
15. My Almond Orchard—Miss Carrie A. Whelan, Oakland, California.
16. Walnut Culture—Dr. W. W. Fitzgerald, Stockton, California.

A NEW APPOINTMENT.

On September 22d, Mr. Leroy Childs of Redlands, California, was appointed assistant secretary of the State Commission of Horticulture. Mr. Childs graduated from Stanford University in May, 1913, and has since then been field assistant of the Bureau of Plant Industry, United States Department of Agriculture, under Dr. E. P. Meinecke, Forest Pathologist for the Pacific coast. At the time of his appointment, he was considering a position which had been offered him by Dr. E. L. Van Dine of the Porto Rico Board of Agriculture, and only the more favorable work in this state induced him to remain in California, to become a member of the commission, in a most needy place. Both Dr. Kellogg and Prof. Doane of Stanford University recommend him most highly. He is certainly amply qualified for the position he now holds and is a most valuable addition to the horticultural work of the State.—E. O. Essig.

JAPANESE LAW RELATING TO INSPECTION OF EXPORTED ORNAMENTAL AND NURSERY STOCK

For years the officers of the Department of Agriculture and Commerce of the Japanese Government have been looking seriously to the passing of a bill to prohibit the exportation of ornamental and nursery stock which was infested with injurious insect pests and plant diseases. It was only recently that such a law has been passed and put into execution in Japan, and inspectors are now busy inspecting and fumigating all ornamental and nursery stock at the main ports where they are shipped to foreign countries.

The history of the California State Quarantine Division at San Francisco has disclosed many facts relative to the importation of horticultural products from Japan, and no doubt the new Japanese law will be warmly welcomed, not only by this division, but by the entire State. The Japanese, on the other hand, have appreciated the efforts of the quarantine officials of California and the great work that has been done in connection with the Oriental staff of quarantine inspectors with a view of protecting not only California, but the entire United States.

The rapid growth of horticulture in Japan at the present day has also made it urgent to establish and maintain a quarantine inspection at the ports of entry, to prevent the importation of nursery stock infested with injurious insect pests and fungous diseases. The Japanese entomologists have prepared a bill providing for this protection, but it has not yet been brought before the Congress at Tokio. In Korea, however, such a law has already been passed and the horticultural quarantine inspectors are already at work at the six largest ports of entry, under the direction of Mr. Kisaka, entomologist of the Korean Agricultural Experiment Station. The passage of such a law in Japan will do much to protect her growing horticultural industries and will aid other countries to a large extent also.—S. Nakayama, Stanford University.

QUARANTINE REGULATION NO. 4.

Peach Yellows and Peach Rosette.

To whom it may concern:

In an endeavor to bring about a safe and sane application of each provision of the State Quarantine Law, the State Commissioner of Horticulture of the State of California has caused diligent inquiry (covering a period of two years) to be made at all sources of information, both official and otherwise, concerning the distribution of "peach yellows" and "contagious peach rosette" in and throughout the United States.

Based upon the findings submitted to the State Commissioner of Horticulture of California by the Missouri State Board of Horticulture as the result of an official orchard survey of that state ordered by the legislature, and which was made and continued over a period of two years, and during all of which period no evidence of "peach yellows" or "peach rosette" was found to exist in the orchards of the State of Missouri;

It is, until further ordered, hereby declared that the provisions of Section 6 of the State Quarantine Law of the State of California do not apply to any district within the boundaries of the State of Missouri.

(Signed.) A. J. Cook,
State Commissioner of Horticulture.

CALENDAR OF INSECT PESTS AND PLANT DISEASES.

By E. J. VOSLER, Assistant Superintendent of the State Insectary.

[Under the above heading the author aims to give brief, popular descriptions and methods of controlling insect pests and plants as near as possible just prior to or at the time when the suggestions given should be carried into effect by the growers.]

DECIDUOUS AND CITRUS FRUIT INSECTS.

The Fall Cankerworm.

The eggs of the fall cankerworm, a pest of apple, prune, cherry and apricot, are attached to the bark of the fruit trees in masses of from 60 to 200, placed side by side in exposed situations, by the wingless females which emerge from the middle of October to the middle of December. Mr. E. O. Essig[1] recommends the use of bands around the tree trunk, placed in September and October, to be renewed occasionally because of the heavy winter rain, to trap the females as they ascend the trunks to deposit their eggs.

Spraying for the Black Scale on Olive.

The use of distillate emulsion, according to the forunla given below, as soon as the olives are picked, is recommended in the ''Injurious and Beneficial Insects of California'', by E. O. Essig:

Distillate Emulsion.

Distillate (28 degrees Baumé)	20 gallons
Whale-oil soap	30 pounds
Water to mix	12 gallons

Dissolve the whale-oil soap in the water, heating it to the boiling point; add the distillate and agitate thoroughly while the solution is hot. For use, add 20 gallons of water to each gallon of the above mixture.

The crude oil emulsion is also recommended as given under the next topic ''Spraying for the Brown Apricot Scale.''

Spraying for the Brown Apricot Scale.

The time is approaching for remedial measures against the well known brown apricot scale, enemy of various deciduous trees, particularly the prune. E. O. Essig recommends spraying with caustic soda distillate water, a chemical mixture, or distillate emulsion and crude oil emulsion, when the trees are dormant. In many cases it is advisable to spray before all the leaves fall. The formula for the distillate emulsion is the same as for the black scale, and the following is the formula for the caustic soda mixture.

Water	200 gallons
Caustic soda (95%)	7 pounds
Distillate (28 degrees Baumé)	10 gallons

Fill spray tank with the required amount of water; add the caustic soda which has been dissolved in a small amount of water, and then the distillate. Keep agitator going rapidly while applying the spray.

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[1] Injurious and Beneficial Insects of California, by E. O. Essig, page 187.

Crude Oil Emulsion.

Water	175 gallons
Liquid soap	3 gallons
Crude oil (direct from wells)	25 gallons

Fill the spray tank with 175 gallons of water; add the liquid soap; agitate thoroughly for one minute, after which add the crude oil, continuing the agitation while the spray is being applied.

Fumigation.

The time is right for the fumigation of black scale in most localities between August 15th and January 1st, though this period may vary in some localities with the hatch of the scale. It is desirable to fumigate as soon after all, or as many as possible, of the young scale are hatched. The three fourths or even the half of the regular schedule No. 1 may be used, the latter especially where the hatch is even and the scale young.

In Tulare County, September seems to be an excellent month for the treatment of the longulus scale. Experiments conducted by Commissioner Schulz indicate the efficiency of a two thirds dosage of Schedule No. 1, which seems to do fully as well as the full dosage.

CEREAL AND FORAGE CROP INSECTS.

The Clover Seed Chalcid.

(*Bruchophagus funebris* How.)

A reduction in the alfalfa seed crop after thrashing, when before there was much promise of a large crop, has often puzzled many of our alfalfa seed growers.

A little insect of the hymenopterous family, Eurytomidæ, very often brings on the foregoing result. The seriousness of this pest may be seen from the statement of one of the experts of the United States Bureau of Entomology working on this pest that fully 50 per cent of the seed crop in certain portions of Arizona, was destroyed by this chalcid.

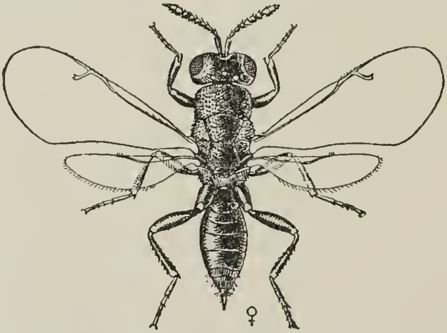

FIG. 379.—The clover seed chalcid, *Bruchophagus funebris* How. Adult female, greatly enlarged. (After Webster.)

The adults are black with brown eyes and light brown feet. The eggs are deposited in the seeds, which, at the time of egg laying, are in a semi-fluid condition. The larvæ, on emerging from the egg, feed on the substance of the seed and often totally destroy the contents.

Infested seeds are light weight and of a grayish color. The winter is spent as a larva in the seeds, which often drop to the ground. The adults from these over-wintering larvæ do not emerge until the following spring, or in the early summer. There are several generations.

The clover seed chalcid, as it is commonly called, will infest the seed of red and crimson clover besides alfalfa, a favorite host.

Remedies for this pest are so far in an experimental stage. Mr. T. D. Urbahns, an expert of the Bureau of Entomology, United States Department of Agriculture, is now working upon the insect in California and possibly will have suggestions to offer on the control of this pest in the near future. Professor F. M. Webster[1] suggests, as preventative measures, the destruction of all outstanding alfalfa plants in the fall and the chaff and stems burned up after threshing. This will go a long way to reduce the numbers of the pest the following years. Delaying the seed crop by early pasturing or clipping of the first growth in the spring until the seed chalcid has done most of its destructive work, holds a promise in the future for control measures.

Another Locust Poison.

Prof. F. M. Webster, in charge of cereal and forage insect investigations, United States Bureau of Entomology, writes that the government of Cape Colony, South Africa, has been using the following mixture for the destruction of locusts, or grasshoppers, as they are commonly called, with apparently excellent success:

> "The mixture consists of one gallon of a treacle, which may be made of a low grade molasses or glucose, or even with dissolved sugar, mixed with a one half gallon water solution of arsenite of soda (69 per cent white arsenic). This mixture is diluted for newly hatched locusts to one part to 66 of water; when used against locusts a couple of weeks old, it is diluted one part to 50 of water. Where the application is made in fields not accessible to domestic animals, farmers have used it as strong as one to 30 or 40."

This mixture appears to be well worth trying under California conditions.

Since the egg pods of grasshoppers are deposited in the hard, uncultivated lands during the late summer and early fall, plowing, harrowing and disking such waste lands to the depth of several inches in the late fall will do much to lessen future attacks.

The Alfalfa Caterpillar.

No doubt many of our alfalfa growers have noticed large green worms with a white stripe on each side of the body, feeding on the leaves of the alfalfa plants. The adults of this worm are the common yellow butterflies, which are numerous in the fields. At this time of the year, the damage done by this insect is much lessened, as many are going into hibernation, besides the destruction of a large number by the wilt disease. Horticultural Commissioner Carl J. Ley, of Glenn County, reported in September that a large percentage of the larvæ of the alfalfa caterpillar were found dead hanging to the alfalfa stalks, as the result of this disease.

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[1] Circular No. 69, p. 9, Bureau of Entomology, U. S. Department of Agriculture.

Renovating alfalfa fields during the winter months will not only be of material benefit to the alfalfa itself, but will destroy large numbers of the hibernating pupæ. Pasturing the alfalfa fields will also aid in the destruction of the resting stage of this insect.

TRUCK CROP INSECTS.

Fall Plowing as a Cutworm Remedy.

An excellent example of fall plowing, as a method for control of cutworms on sugar beets, was observed near a small town in Salt Lake County, Utah, by the writer, in the spring of 1912. Several acres of sugar beets were planted that year, part of which were on soil plowed the previous fall and the remainder on land plowed several weeks before planting. Practically 75 per cent of the sugar beets on the spring plowed land were killed by the cutworms, while a good stand was secured in the fall plowed portion of the field. The question arises, did fall plowing pay?

The Tomato Worm.

Various reports of the damage to tomatoes by the corn ear worm, *Heliothis obsoleta,* have been received by the State Insectary force, particularly from the field agents of the Libby, McNeil and Libby canning plant at Sacramento. The worms eat large holes in the fruit, bringing on decay. From the present equipment for washing tomatoes in the canning factories, it is not advisable to spray the tomato vines with any form of arsenic in the hope of killing the worms as they endeavor to enter the tomatoes.

The use of an early trap crop, as well as early maturing varieties, the hand-picking of infested tomatoes to prevent the worms spreading, fall plowing of infested ground, and the proper disposal of unsalable, infected tomatoes, will go a long way to protect the next year's crop.

FUNGOUS DISEASES OF PLANTS.

Spraying for Peach Blight.

As a remedy for the peach blight fungus, the California Experiment Station in Bulletin No. 191, recommends spraying, between October 25th and November 25th, with Bordeaux mixture, using 30 pounds bluestone, 35 pounds lime, to 200 gallons of water. This fungus begins its work in the fall and the peach trees must be sprayed at that time. The disease causes dead spots to appear on the young shoots during the winter months, particularly at the buds. The buds are killed, together with much of the young growth.[1]

In February, the use of lime-sulphur solution of Bordeaux mixture, 20-20-200, will control the peach-leaf curl fungus. This fungus curls the leaves, which afterwards fall, together with some of the fruit.

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[1] Bulletin No. 218, California Exp. Sta., p. 1149.

One Cause of the Failure of Tomatoes to Set Fruit.

The attention of the State Commission has been called by various truck gardeners in and around Sacramento to the failure of tomato vines to set fruit after a large number of blossoms had formed. The vines were thrifty and blossomed well. The flowers would hang on the vines for a certain period of time, then fall off, leaving part of the peduncle attached to the stem.

Specimens were sent to Mr. H. S. Fawcett, then plant pathologist of the State Commission, who determined the fungus as a species of *Macrosporium,* possibly that species known to cause the late blight of potatoes and the fruit spot of tomatoes. The writer placed several stems and blossoms of an infested tomato plant in a moist chamber for several weeks, and on examination, thousands of spores of this fungus were obtained.

A grower used 10 pounds of precipitated sulphur to 100 gallons of water on his tomato vines which had hitherto failed to set fruit, and was rewarded by a fair crop of tomatoes. Mr. H. S. Fawcett advised the use of Bordeaux mixture in an experimental way.

MONTHLY CROP REPORT—SEPTEMBER.

Inasmuch as practically all of the deciduous crops have been harvested it was thought best to make this last report in the form of a summary of general conditions. To obtain the necessary data the following information was requested of the county horticultural commissioners:

1. General conditions of crops for the year, whether good, poor or normal.
2. Returns for crops compared with other years.
3. General conditions of crops not yet harvested.

The following responses of the horticultural commissioners have been published in full:

El Dorado County:

Crop conditions in this county have been a fair average with the exception of grapes, while prices have been better than last year.—J. E. Hassler.

Fresno County:

Alfalfa—normal crop; condition good; returns 100 per cent. *Apricots*—50 per cent crop; condition poor; returns 50 per cent. *Figs (California black)*—120 per cent crop; condition good; returns 125 per cent. *Grapes (raisin)*—60 per cent crop; condition poor; returns 50 per cent. *Grapes (table)*—60 per cent crop; condition poor; returns 60 per cent. *Grapes (wine)*—80 per cent crop; condition normal; returns 120 per cent. *Lemons*—75 per cent crop; condition good. *Olives*—150 per cent crop; condition good. *Oranges*—normal crop; condition good. *Peaches (canning)*—70 per cent crop; condition normal; returns 100 per cent. *Peaches (drying)*—70 per cent crop; condition normal; returns 100 per cent. *Plums (canning)*—100 per cent crop; condition normal; returns 100 per cent.—F. C. Schell.

Kings County:

Alfalfa—normal crop; condition normal; returns $9 to $12.50 per ton. *Apricots*—37½ per cent crop; condition affected by frosts; returns 33 per cent higher than 1912. *Grapes (raisin)*—60 per cent crop; condition affected by frosts and drought but fruit firm; returns raisin exchange prices. *Grapes (wine)*—60 per cent crop; condition affected by frosts and drought but fruit firm; returns $10 to $12 per ton. *Peaches (canning)*—80 per cent crop; condition affected by frosts and drought; returns 35 per cent above 1912. *Peaches (shipping)*—80 per cent crop; condition affected by frosts and drought; returns 35 per cent above 1912. *Peaches (drying)*—80 per cent crop; condition affected by frosts and drought; returns 40 per cent higher than 1912. *Prunes*—50 per cent crop; heat caused dropping; returns 50 per cent above 1912.—B. V. Sharp.

Lake County:

The fruit crop of Lake County this year has been of good quality. The *grain* and *hay* crop has also been of good quality. *Hops* have been up to the average in quality. *Wine grapes* have done well. *Apples, almonds* and *prunes* are a short crop. *Bartlett pears* are 75 per cent of last year's crop. The amount of *grain* and *hay* in quantity will compare favorably with former years. Although the fruit crop is short the cash returns will be up to the average on account of high prices. *Wine grapes* will make better returns than usual.—Geo. A. Lyon.

Madera County:

Alfalfa—general condition good; returns above normal. *Almonds*—general condition fair; returns normal. *Apples*—general condition good; not harvested yet. *Apricots*—general condition poor; returns poor; below normal. *Figs*—general condition fair; returns normal. *Grapes (raisin)*—quantity 55 per cent; quality poor; returns equal 1912. *Grapes (Thompson's seedless)*—price will be about double of last year. *Grapes (wine)*—looks like 65 per cent; price better than last year; returns equal to last year. *Hay*—general condition good; returns about like last year. *Olives*—general condition good; returns better than last year. *Peaches*—general condition fair; *Peaches (drying)*—old orchards 35 per cent to 40 per cent short; young orchards bring it up to 80 per cent of normal; returns less than normal. *Peaches*—*(shipping)*—general condition good (dried). *Pears*—general condition good; dried and sold locally; returns normal. *Prunes*—general condition fair; returns better than normal.—Geo. Marchbank.

Nevada County:

Alfalfa—crop 110 per cent, due to rains that extended through June. *Almonds*—*IXL*, crop 20 per cent; *Ne Plus Ultra*, crop 20 per cent, due to frost. *Apples*—*Bellflower*, crop 60 per cent; *Gravenstein*, crop 60 per cent; *Newtown Pippin*, crop 60 per cent; other varieties, crop 60 per cent, due to rain during blossoming time, preventing proper pollination. *Apricots*—*Blenheim*, crop 30 per cent; *Moorpark*, crop 30 per cent; *Royal*, crop 30 per cent, due to cold rains and freezing at time young fruit was setting. *Berries*—*Blackberries*, crop 100 per cent; *Loganberries*, crop 100 per cent; *Raspberries*, crop 100 per cent; *Strawberries*, crop 100 per cent; other kinds, 100 per cent. *Cherries*—*Black Tartarian*, crop 75 per cent; *Lambert*, crop 75 per cent; *Royal Anne*—crop 75 per cent; other varieties, crop 75 per cent, due to frost. *Figs*—*California Black*, crop 90 per cent; *Smyrna* types, crop 90 per cent; *White Adriatic*, crop 90 per cent; first crop slightly hurt by frost. *Grapes (raisin)*—*Muscat*, crop 80 per cent; *Sultana*, crop 100 per cent; *Thompson's Seedless*, crop 100 per cent; other varieties, crop 100 per cent. Short *Muscat* crop due to sun scald. *Grapes (table)*—*Malaga* crop 100 per cent; *Tokay* crop 90 per cent; other varieties crop 100 per cent.

Short *Tokay* crop due to sun scald. *Grapes (wine)—Zinfandel* crop 100 per cent; other varieties crop 100 per cent. *Hay*—crop 120 per cent, due to late rains. *Olive (Mission*—crop 100 per cent. *Peaches (canning)—Levy,* crop 50 per cent; *Phillips' Cling,* crop 50 per cent; *Tuskena* crop 505 per cent, due to frost. *Peaches (drying)—Crawford,* crop 50 per cent; *Muir* crop 80 per cent; *Lovell* crop 30 per cent, due to frost. *Peaches (shipping)—Elberta* crop 80 per cent; other varieties crop 50 per cent, due to frost. *Pears—Bartlett,* crop 70 per cent; other summer varieties, crop 75 per cent; winter varieties, crop 75 per cent. Continuous rains at time of blossoming prevented pollination. *Plums (canning)—Green Gage,* crop 80 per cent; *Yellow Egg,* crop 80 per cent; *Hungarian,* crop 80 per cent; due to frost. *Plums (shipping)—Tragedy,* crop 70 per cent; other varieties, crop 80 per cent, due to frost. *Potatoes*—crop 125 per cent, due to late rains. *Prunes—French,* crop 90 per cent, due to frost. *Walnuts—Softshells,* crop 90 per cent; *Budded,* crop 90 per cent; *Franquette,* crop 90 per cent; other varieties, crop 90 per cent, due to frost.

Agricultural conditions good. *Hay* and *grain* 10 per cent above average; *potatoes* 25 per cent above average; crop not all harvested. Other agricultural products fully up to average; good market and better prices than last year; conditions of crops not harvested, good. Horticultural: Crop 60 per cent of normal; better prices prevailed than in former years; our *Bartletts* selling from $2.85 to $3.50 per box. *Apples* and *winter pears* not harvested; crop 60 per cent of normal; in good condition.—D. F. NORTON.

Merced County:

Alfalfa—large crop. *Almonds*—crop 10 per cent. *Apples*—crop 90 per cent. *Apricots*—crop 10 per cent; *Beans (black eyed)* full crop. *Berries—Blackberries,* crop 100 per cent; *Loganberries,* crop 100 per cent; *Strawberries,* crop 100 per cent. *Figs—California Black,* crop 100 per cent; *Smyrna* types, 100 per cent; *White Adriatic,* 100 per cent. *Grapes (raisin)—Thompson's seedless* crop 60 per cent; *Grapes (table)—Malaga*—crop 75 per cent; Tokay crop 50 per cent; *Grapes (wine)* crop 75 per cent; *Zinfandel* crop 75 per cent. *Hay*—crop 30 per cent; *Lemons*—crop 30 per cent; *Olives—Manzanillo,* crop 100 per cent; *Mission,* crop 100 per cent; other varieties, crop 100 per cent. *Oranges (Navel)*— crop, 50 per cent; *Peaches (drying)*—crop, 40 per cent; *Crawford,* crop, 40 per cent; *Muir,* crop, 60 per cent; *Lovell,* crop, 40 per cent. *Peaches (shipping)—Elberta,* crop, 60 per cent. *Pears (Bartlett)* crop, 50 per cent; winter varieties, crop 90 per cent. *Plums (shipping)* crop, 40 per cent. *Potatoes (sweet),* crop very large. *Walnuts,* crop 100 per cent.—N. H. WILSON.

Modoc County:

The general condition of our crops for this year was splendid. The returns, as compared with other years, have been better. The condition of crops not yet harvested, is good.—O. C. MCMANUS.

Monterey County:

Almonds—crop, 125 per cent. *Apples*—crop, 15 per cent. The last injury was by the hot spell, September 15th to 18th. *Apricots*—crop, 150 per cent. *Cherries*—crop, 75 per cent; *Grapes (wine)*—crop 60 per cent; *Grapes (table)*—crop, 50 per cent. *Olives*—crop 50 per cent. *Peaches*—crop, 80 per cent. *Pears*—crop 75 per cent. *Plums (shipping)*—crop, 75 per cent. *Prunes*—crop, 70 per cent.—J. B. HICKMAN.

Placer County:

The deciduous fruit season is about ended. The general condition of crops this season has been good and we have harvested between 65 per cent and 70 per cent, it is estimated. The returns have been better than usual, so that growers will be as well off, financially, as in other years. Crops yet to be harvested, viz., *olives* and *oranges,* are showing up well and we will have an average crop.—H. H. BOWMAN.

Riverside County:

Almonds, apricots, peaches, have all produced full crops of first class fruit, and prices received for same have been very satisfactory. Production of above varieties will run 25 per cent to 30 per cent above last year. *Cherries* also produced above a normal crop, with good prices for most of the output. *Grapes,* both wine and table, have suffered some from sunburn, but the yield will be up to that of last year. Prices for table varieties have been satisfactory. Our wine grape acreage is nearly all in the hands of large concerns, who have their own facilities for manufacturing wine, hence am unable to give very accurate information as to prices being paid for grapes to outside parties. *Lemons* in the Riverside district will yield a light crop this season. The Corona section is shipping almost its usual quantity of this fruit and very satisfactory returns are the rule. The citrus, including all varieties will, we estimate, run about 65 per cent of normal throughout the county, Corona district leading in quantity per acre. *Pears* and *prunes* are grown commercially in limited quantities in our county. Crops of above varieties have been good, and good prices have prevailed for same. *Walnuts* now being harvested will run 80 per cent to 85 per cent normal crop, with prices good. *Olives* promise a good crop of fine fruit with satisfactory offerings for the output, both oil and pickling varieties. Our citrus groves in sections that were severely injured by last season's cold, are recovering in splendid shape, and barring any further calamity of similar nature, should practically reach their normal production during the 1914 crop. This, I think, will be especially true of oranges; lemons will probably not reach normal production before 1915 crop.—R. P. CUNDIFF.

Sacramento County:

Deciduous—in quantity, below average; quality, good; prices, good. *Citrus*—in quantity, about an average crop. *Hay*—nearly an average crop; quality good; prices good. *Grain*—not quite an average crop; quality, good; prices, good. *Vegetables*—nearly an average crop; quality good; prices good. As a whole, crops below normal, with prices above normal. Returns are better than average year. Wherever irrigation is being resorted to, crops are doing fine, and look as well as in the ordinary year—F. R. M. BLOOMER.

San Bernardino County:

The returns for crops as compared with last year or other years is difficult to ascertain, as there are numbers of packing houses with no one near from whom to get reports. The railroads can give us shipments, but not returns. However, the report of our Exchange, by G. Harold Powell, gives the most definite information for the whole Exchange, viz.: "The f. o. b. average price is 47 per cent higher than the average for 1911–1912." It goes to show that because of this, even though the shipments are only 53 per cent of last year's, the f. o. b. returns equal 79 per cent of the returns of 1911–1912. Of course, this applies to the whole district, not merely our county, but this will give an idea of how the returns compare. I have some figures on the county, but they vary so that I do not consider them suitable for publication. The report in some localities on some kinds of fruit shows some poor and some normal. *Alfalfa*—100 per cent of normal crop. *Apples*—92 per cent crop. *Grapes (raisin)*—80 per cent crop. *Lemons*— 20 per cent of normal crop. *Olives*—55 per cent crop. *Oranges*—75 per cent crop. *Peaches*—95 per cent crop. *Pears*—95 per cent crop. *Prunes*—90 per cent. *Walnuts*—95 per cent crop.—S. A. PEASE.

San Joaquin County:

Peaches, clings—very light crop, about 20 per cent. *Levy clings*—full crop. *Phillips' clings*—very light crop; about 30 per cent. *Muirs*—a fair crop; about 60 per cent. *Lovells*—very light crop; about 20 per cent. *Elberta*—very light crop; about 40 per cent. *Plums (shipping)*—crop about 80 per cent. *Prunes (French)*—crop about 80 per cent. *Prunes (Sargents)*—crop about 30 per cent. *Grapes (wine)* yield from 1,000 pounds to 2½ tons to the acre, and up. *Grapes (table)* taking the county altogether, will not average much over a ton to the acre fit for shipping. *Vegetables* of all kinds are very scarce and high. *Potatoes* are going out at the rate of about 40 cars per day and are of very fine quality. They are yielding from 30 to 200 sacks per acre. General conditions: The dry seasons succeeding each other have resulted in a shortage of moisture to a depth of from 13 to 30 feet, and in many instances orchards not irrigated have not been able to mature the fruit in a normal condition. On the other hand, the dry season has been productive of some good results, in that the orchardists have installed pumping plants, and by the aid of irrigation, have procured good crops, which, in the future, will render them more independent of the rainfall. Another thing which I have observed this summer is that the orchards and vineyards which were irrigated previous to the starting of the growth have proved more satisfactory; first, they have borne the heaviest crops; second, they have not suffered from sunburn, which the late irrigated vineyards have. In my opinion, this sunburn is due to a large extent to a development of a surface root system for which late irrigation is responsible, in that it brings the roots near enough the surface so that, when an extremely hot spell comes, it is the roots that suffer from the heat, and the foliage depending on those roots shows the damage done. As proof of my conclusion, orchards and vineyards which have never been irrigated late, but have been irrigated before the growth starts, and having an abundance of moisture deeper in the soil, and held by thorough cultivation, were not so injured. Trees or vines under the last mentioned condition show no signs of the extreme dry season by sunburn; grapes grown under the last mentioned condition are much finer in quality, size and crop, and are not ready for shipping yet. The peach crop has been very uneven in this county, on account of late frost, some orchards having all the trees could carry, while others had scarcely any fruit.—W. M. GARDEN.

Santa Barbara County:

Alfalfa—crop normal. The alfalfa area is being constantly extended, and the gross product is increasing. *Apples*—Crop 100 per cent actual; acreage of varieties not available. *Apricots*—Crop 100 per cent actual, mostly Royals. *Beans*—75 per cent crop; dry year. *Lima*, 90 per cent, due to irrigation. *Small white*, 65 per cent; dry year; other varieties, 70 per cent. *Cherries*—crop 110 per cent; new bearing trees. *Figs*—crop 100 per cent. *Grapes (wine)*—crop 100 per cent. *Hay*—crop 75 per cent, due to dry year. *Lemons (Eureka, Lisbon)*—crop 96 per cent, due to cold winter. All are setting full and will return to normal, or better. *Olives*—crop 190 per cent, being the fruitful year. *Oranges*—crop 100 per cent. The orange outlook is especially good. *Peaches*—Peaches with us are sold in the fresh fruit market and embrace most of the varieties in all classes. *Peaches (shipping)*—crop 100 per cent. *Pears*—crop 100 per cent. *Potatoes*—crop 90 per cent. Dry year makes crop short. *Prunes*—crop 100 per cent. *Walnuts*—crop 198 per cent. Aphids and blight not so severe as in 1912. A hot wave has damaged nuts 20 per cent in price, not in tons. *General crop conditions*: At one time it looked as though the *apple* crop would suffer from short rainfall, but nothing of the sort has shown up in the crop now being gathered. *Lemons* having been in demand, the returns from crop are greatly in excess of any previous year. I should estimate at least 50 per cent better returns to the grower than previous years. This, with new plantings coming to fruit, makes the income to the county quite considerable. The *lemon* area is being extended quite noticeably, and young trees are coming to fruit, promising much for succeeding years. The *hay* and *grain* crops were short; the hay crop quite normal, owing to many acres usually gathered as grain being cut for hay, the result of dry conditions at time of hay making. Hay prices are 20 per cent higher than usual. The returns from hay and grain are below normal by about 25 per cent. *Beans* are not filling well on dry, sandy land, nor are they doing usually well on adobe that was not worked at its best. Clayey soils are making a poor yield, except where irrigated. Irrigated portions are producing nearly 50 per cent above normal crop. Prices are stiff and buyers eager, making the net returns from all sections quite favorable. *Cherries* are proving remunerative and dependable, and acreage is being extended in cherry districts. *Alfalfa* is increasing in area so rapidly as to make comparison wholly misleading.

Three times the area is now in process of planting of two years ago, while productiveness is gaining, through improved methods of culture and innoculation of seed. The *avocado* industry is receiving much attention and several acres are being planted to this fruit. *Spineless cactus* is gaining a wide planting, but very few, if any, of our farmers have succeeded in getting their stock to take to the new forage. Reports thus far are to the effect that stock has to be starved to eating the food, and they refuse to touch it when other food is available. None seem to form a fondness for it thus far. Even the accommodating hen does not take to it. The general conditions of crops for the year are fully normal, and returns will equal normal. What is lost on short crops is made up in price or by increase on other commodities. The unharvested crops promise full normal returns, with possibly an exception in the bean crop.—C. W. Beers.

Santa Cruz County:

The *apple* crop has been considerably damaged by the recent hot weather, 15 per cent to 50 per cent, according to conditions. The total output of shipping apples will probably not exceed 600 cars, but culls are abundant—about normal supply. Shipping stock is moving rather freely at $1.00 to $1.25 per box f. o. b., and higher prices are obtained in some cases. Considerable fruit is going into cold storage. The grades of Newtown culls are bringing $9.00 per ton, with drying stock at $7.00. The market conditions are a decided improvement over last year, but the almost total failure of the crop will prevent this district from deriving much benefit. *Beets* are the best crop this valley has this year. The 800 acres in this year are estimated at 11,000 tons. The minimum price is $5.50 per ton, but the average should be between $6.00 and $7.00. The acreage is about twice that of last year and yield is considered normal. *Potatoes* are very poor this year, only a small acreage and very light yield which may be placed at 25 per cent crop. *Berries,* referring largely to *strawberries,* but including *black-* and *loganberries,* have produced heavily this year. Market conditions have been poor and frequently glutted to a serious extent. Prices have ranged from $8.00 to $3.00 per crate, with large quantities going for $4.00 or less. Very small profits and positive losses have resulted. The acreage is on the increase, owing to past records and anticipation of a large market in 1915. The total output this year is about 300,000 crates. *Apricots* were about 66⅔ per cent normal crop, with good prices and fairly free movement. The product of 1,000 tons dry sold from 10¢ to 14¢. *Oranges* were about 50 per cent crop and sold for good prices.—W. H. Volck.

Shasta County:

Our fruit crops are all off the trees and vines. The *Winter Nellis* pear crop is not being shipped. The crop was good, as also are the sizes. The *Bartlett* crop was not as good as last year, and much of the fruit was infested with codling moth, which cut the shipping tonnage down considerably. The fruit crop in general was not near normal, that is, in general over the county. In fact, aside from *pears* and *prunes,* there was no fruit crop in the valley proper. The Happy Valley section had a good crop generally, of all kinds of fruit. The *peach* crop was good, but the infestation of peach moth was very bad, and we expect to plan a district and make a general spraying order for all the orchards the coming season, and enforce a clean-up. The prices of the green fruit in that section were 30 per cent to 40 per cent more than for three previous years. Our *hay* and *grain* crops were all good over the country, the Fall River section having a bumper crop. Our *alfalfa* acreage is increasing and there will be quite a planting the coming season. The hay and grain prices range about the same as previous years, with the exception of grain hay, which is 25 per cent higher than last year.—Geo. A. Lamiman.

Solano County:

Alfalfa—crop 90 per cent. *Almonds*—crop 65 per cent. *Grapes (table)*—crop 60 per cent. *Peaches*—crop 90 per cent. *Pears*—crop 70 per cent. *Prunes*—crop 75 per cent. *French prunes* and *pears* have been in a demoralized condition the latter part of the season. They averaged smaller than last season. Many fresh prunes shriveled before maturity. *Pears* became half sized—all due to dryness. *Tokay* shipments are very light at present, about one car per day leaving the county. Some new drying prunes, one of which is the *Standard,* have developed well on young trees. They have reached normal size, which is about the size of the Grand Duke plum. *Peaches* at Winters and Suisun are normal in size; at Vacaville they are normal in most orchards, but in some they average very small; in some orchards too small to use.—C. R. McBride.

Sonoma County:

General conditions of crops for year: The general conditions of crops in Sonoma County for the year are below the average, running from 50 per cent to about normal for *hops* and *grapes.* Returns for crops compared with other years: The financial returns for crops will approximate the average for other years as the higher prices will make up for the shortage in production. General conditions of crops not yet harvested: The late *apples, corn, tomatoes, potatoes, grapes,* etc., are below the average, with the possible exception of wine grapes, which seem to be nearly an average crop.—A. R. Gallaway.

Stanislaus County:

Alfalfa—crop 110 per cent, due to more water; returns $10 to $12 per ton. *Almonds*—crop 5 per cent, due to frost; returns 15¢ per pound. *Apples*—crop 100 per cent returns 1c green. *Apricots*—crop 10 per cent, due to frost; returns 2½¢ green. *Beans*—crop 100 per cent; returns 4¢. *Berries*—crop 100 per cent; returns, 8¢. *Cherries*—crop 50 per cent; returns 8¢. *Figs*—crop 125 per cent; returns, 3¢. *Grapes (wine)*—crop 80 per cent; returns, $12 to $14 per ton. *Grapes (table)*—crop 80 per cent; returns $20 to $25 per ton. *Lemons*—crop 50 per cent; trees killed last winter. *Olives*—crop 125 per cent; returns $17 to $25 per ton. *Oranges*—crop 100 per cent;

returns, $1.00 per box. *Peaches*—crop 35 per cent; returns at cannery, green, $12.50 to $25 per ton. *Pears*—crop 75 per cent; returns, $35 per ton. *Plums (shipping)*—crop 100 per cent; returns, 2¢ per pound. A. L. RUTHERFORD.

Ventura County:

Apricots all harvested; yield approximately 1,700 tons of dried fruit, compared with 2,400 tons last season. *Bean* harvest well under way; prospects at present not over 90 per cent of last year. Price from 4½ cents to 5 cents. *Beets* over half harvested, with prospect of normal sugar yield. Prospects for *lemons* for the coming season almost normal. *Oranges,* prospects for the coming season almost normal. Recent hot weather has lowered the estimate on walnuts from 105 per cent of last year's crop to 95 per cent of same. *Walnut* harvest has just commenced.—R. S. VAILE.

Tehama County:

Alfalfa—crop 100 per cent. *Almonds*—crop 10 per cent, due to spring frosts. *Apples*—crop 25 per cent, due to over-production in 1912. *Apricots*—crop 75 per cent, due to dry season and spring frosts. *Grapes (table)*—crop 75 per cent, due to hot weather in early July. *Grapes (wine)*—crop 100 per cent. *Hay*—crop 100 per cent, due to late spring rains. *Lemons*—crop 100 per cent. *Olives*—crop 50 per cent, due to dry season and hot north winds in blossoming time. *Oranges*—crop 100 per cent. *Peaches (drying)*—crop 40 per cent; *Crawford,* crop 40 per cent; *Muir,* crop 40 per cent; *Lovell,* crop 40 per cent; other varieties, crop 40 per cent; due to spring frosts and dry weather. *Peaches (shipping)*—crop 40 per cent; *Alexander,* crop 40 per cent; *Elberta,* crop 40 per cent; other varieties, crop 40 per cent; due to spring frosts and dry weather. *Pears*—crop 10 per cent, due to blight. *Plums (shipping)*—crop 100 per cent. *Prunes*—crop 30 per cent, due to dry season and hot winds in July.—CHAS. B. WEEKS.

Yolo County:

It is too early to give final figures of this season's output of some of Yolo County's principal products, as *raisins* and *prunes* are only partly harvested; *almonds* are now being shipped, and *sugar beets* are to some extent still in the field. *Almonds* are turning out 60 per cent of a normal yield with the exception of *Nonpareil,* which had almost an average yield. *Prunes* are yielding from 40 per cent to 50 per cent; rather shy at that, in localities where no irrigation is practised. *Peaches,* 60 per cent; *Figs,* practically full crop, and *grapes*—for raisins and wine—from 60 per cent to 90 per cent. The large variation of yield is accounted for by the difference in water supply.—G. H. HECKE.

INSECT NOTES.

Conducted by the editor.

Asterolecanium variolosum (Ratz.) has been reported as working upon oak trees at Stockton by Frederick Maskew.

Tomicus confusus Lec. has been sent in by Mr. J. W. Hough from Claremont, Cal., who reported it as doing serious damage to young Monterey Pine trees (*Pinus radiata* Don.) The species was determined by Mr. Charles Fuchs.

A new Kermes has been recently collected in Southern California by the editor and by Commissioner S. A. Pease. Mr. George B. King, who is revising the genus has so made the statement. It works upon the Coast live oak (*Quercus agrifolia* Neé). It was collected by the writer at Santa Paula, Cal., in 1910, and by Mr. Pease at San Bernardino in 1913. In shape it greatly resembles *Kermes nigropunctatus* Ehr. & Ckll., but appears lighter in color.

Eleodes gigantea var. *estriata* Casey has recently been collected at Davis, Cal., by the writer. Dr. Blaisdell states that it has never before been reported so far north.

The billbug injuring small grain, described by Mr. Harry S. Smith in The Monthly Bulletin, Vol. II, No. 8, pp. 619–621, Aug., 1913, is composed of two varieties, according to Dr. Edwin C. Van Dyke, as follows: Those with no white vittæ on the dorsum of the elytra, *Sphenophorus discolor* Mann.; those with white vittæ on the dorsum of the elytra, *Sphenophorus pictus* Lec. According to this classification, the illustrations on page 620 would be of *S. pictus* Lec. or would occupy an intermediate position between the two extremes of the two varieties of one species.

Mealy bugs are reported by Commissioner F. C. Schell as damaging grape vines in his county. Commissioner R. S. Vaile reports an unusual number of young citrus mealy bugs (*Pseudococcus citri* Risso.) this fall.—E. J. Vosler.

The alfalfa caterpillar, *Eurymus eurytheme* (Boisd.), has been greatly reduced by a wilt disease, according to reports received from Commissioner Carl J. Ley.—E. J. Vosler.

The Western twelve-spotted cucumber beetle, *Diabrotica soror* Lec. is still damaging squash blossoms in the gardens in and around Sacramento.—E. J. Vosler.

Crickets are reported eating holes in garments by several parties in Sacramento.—E. J. Vosler.

The pear-leaf blister-mite, *Eriophyes pyri* Pgst., is reported as now going into hibernating quarters (September 26, 1913) by Mr. Geo. P. Weldon, who observed the young moving from the leaves to the buds and into places of protection. His observations were made in El Dorado County.

NOTES FROM THE COUNTY COMMISSIONERS.

By GEO. P. WELDON, Chief Deputy State Commissioner of Horticulture.

Humboldt County.

Mr. George Weatherby, County Horticultural Commissioner of Humboldt County, is planning for considerable spraying demonstration work this coming spring. Quite a heavy loss of apples and pears has been occasioned by scab and aphis the past season. Proper spraying at the opportune time should reduce the damage to a minimum. Mr. Weatherby hopes to be able to get such results that those who are careless or negligent with their spraying may see where it is to their advantage to improve their present methods.

Madera County.

County Horticultural Commissioner George Marchbank reports the alfalfa butterfly as being very common in his county, and expresses fears that it may be abundant again next season.

Sutter County.

County Horticultural Commissioner H. P. Stabler of Yuba City, is planning a campaign against the red spider the coming season. This pest has been very destructive to almond, prune, and peach, where no remedial measures have been used.

QUARANTINE DIVISION.

REPORT FOR MONTH OF AUGUST, 1913.

By Frederick Maskew, Chief Deputy Quarantine Officer, San Francisco, California.

As is customary, we herewith publish an account of the volume of work accomplished, also a list of the insect pests and plant diseases intercepted at the horticultural quarantine lines in California during the month of August. We have patiently determined the nature and identity of these organisms, and given to them their technical names, for the purpose of an official record. We are well aware that these learned terms refer to subtleties difficult to comprehend, and of very indifferent importance to those most vitally concerned, and we apply them only to satisfy the scientific world that we actually know what we are doing in this matter. What we, as horticultural quarantine officers, are really concerned about, is to prevent any additional entomological or pathological revenue collectors from establishing themselves in California and adding their annual tax to the present cost of crop production.

During all of the month we have pursued the uneven tenor of our way, and in consonance with the simple code of ethics that dominate the service, have passed all horticultural imports that complied with the provisions of the state quarantine law and the regulations of the plant quarantine act; treated, returned or destroyed all such as did not, and have invoked the aid of the law on all violators of the quarantines on fruit fly material. We have found the pupæ of flies in the folded tops of automobiles, and as a result, have drafted and urged the passage of a regulation preventing in the future any motor car arriving from Hawaii from leaving the dock upon which it was landed until the same has been inspected and passed by the quarantine officers. We have formulated a policy of action looking to the working in unison of the great interior quarantine service of the State with that of the coast division and the collaborators of the United States Department of Agriculture, and which, if successful, will eventually give to California the most complete horticultural quarantine system of any country in the world.

SAN FRANCISCO STATION.

Horticultural imports.

		Parcels.
Ships inspected	37	
Passed as free from pests		44,363
Fumigated		2,929
Fumigated and returned		498
Destroyed or returned		159
Contraband destroyed		45
Total parcels horticultural products for the month		47,994

Horticultural exports.

	Parcels.
Inspected and certified	4,813

Pests Intercepted.

From Honolulu—

Fruit fly larvæ and eggs in string beans.
Dipterous pupæ in folded top of automobile No. 1072.
Bruchus sps. in seed pods.
Diaspis bromeliæ and *Pseudococcus* sps. on pineapples.
Cylas formicarius and *Cryptorhynchus batatæ* in sweet potatoes.
Lecanium sps. and aphids on betel leaves.
Ceroplastes sps. on plants.

From United States Hawaiian Experiment Station—

Diaspis echinocacti on *Opuntia* sps.
Asterolecanium sps., *Pseudaonidia* sps., *Coccus longulus* and *Saissetia nigra* on Hibiscus cuttings.
Pseudaonidia sps., *Howardia biclavis* and *Chrysomphalus aurantii* var. *citrinus* on Jasmine plants.
Fungi on sweet lime cuttings.

From Tahiti—

Chrysomphalus aurantii, *Morganella maskelli*, *Lepidosaphes beckii* and fungi on oranges.
Hemichionaspis minor on cocoanuts.
Chrysomphalus dictyospermi and *Icerya seychellarum* on mango trees.

From New Zealand—

Leucaspis sps., *Eriococcus* sps., *Aspidiotus* sps., and *Saissetia oleæ* on *Podocarpus ferruginea* and *Myrtus bullata*.

From China—

Ephestia elutella on walnuts and peanuts.
Pseudaonidia trilobitiformis, *Chionaspis citri*, *Aspidiotus* sps., *Lepidosaphes beckii* and *Phomopsis citri* on pomelos.

From India—

Lepidopterous larvæ and coleopterous larvæ in Cashew kernels.

From Japan—

Aleyrodes sps. on plants.

From Belgium—

Diaspis echinocacti on *Opuntia* sps.

From New Jersey—

Diaspis boisduvalii on orchids.

LOS ANGELES STATION.

Horticultural imports.

		Parcels.
Ships inspected	20	
Passed as free from pests		19,034
Fumigated		14
Destroyed		3
Returned		--
Contraband		--
Total parcels horticultural products for the month		19,051

Pests Intercepted.

From Florida—

Saissetia oleæ on avocado tree.

From Kentucky—

Pseudococcus citri on unidentified plant.

From Illinois—

Pseudococcus citri on unidentified plant.

From Massachusetts—

Chrysomphalus biformis, *Chrysomphalus ficus*.
Chrysomphalus perseæ, *Diaspis boisduvalii*.
Diaspis echinocacti and *Lepidosaphes* sps. on orchids.

From New Jersey—

Pseudococcus citri and *Pseudococcus longispinus* on crotons.
Aspidiotus hederæ, *Chrysomphalus ficus* and *Pseudococcus longispinus* on Kentia palms.
Orthezia insignis on Rhapis palms.

SAN DIEGO STATION.

Horticultural imports.

		Parcels.
Ships inspected	30	
Passed as free from pests		1,277
Fumigated		--
Destroyed		1
Returned		--
Contraband		14
Total parcels horticultural products for the month		1,292

SANTA BARBARA STATION.

Ships inspected	1

No horticultural imports.

EUREKA STATION.

No report.

A FORTUNATE FIND.

By Lee A. Strong, State Horticultural Quarantine Inspector.

Probably nothing in the annals of the Quarantine Division has served to so vividly show the imminent danger and consequent disastrous results of the introduction into California of the Mediterranean fruit fly (*Ceratitis capitata*) as the following incident which occurred on the arrival in San Francisco of the Oceanic Steamship Company's steamer "Ventura" on April 25, 1913, from the antipodes via Honolulu, T. H.

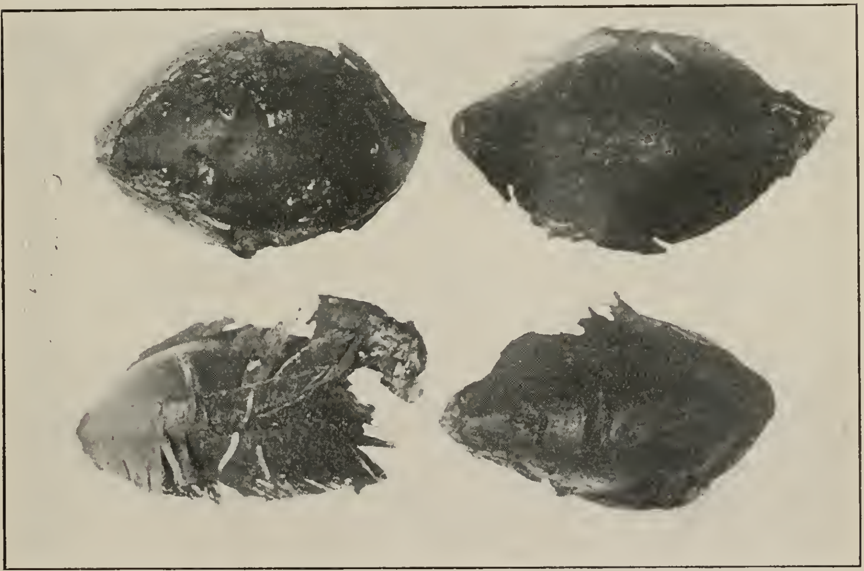

Fig. 380.—Kamani nuts infested with living larvæ of the Mediterranean fruit fly (*Ceratitis capitata* Wied.), destined for planting in Southern California, but confiscated and destroyed by the author. (Photo by Chatterley.)

During the regular procedure of baggage inspection by the United States Customs authorities, the writer was called by Customs Inspector Graham to pass upon several lots of Algoroba beans among a number of child's toys in a small telescope bag. These beans, not being a host of the fruit fly, and showing no sign of insect infestation, were passed, and the passenger was asked whether she had anything more in the way of seeds or fruit. She replied that her husband had in his pocket five seeds of the "Hypocrite tree," grown in a churchyard in Honolulu. She also stated that they contained no insects, as her little daughter had played with them in the cabin during the voyage from Honolulu, and had there been any maggots or other insects in them they would most certainly have been discovered; that the beauty of the tree so impressed her, she wished to grow some like it, and was taking the seeds to southern California to be planted.

Upon examination, the seeds proved to be the "Kamani nut" or "tropical almond" (*Terminalia cattapa*), a hard nut, very like in form to an almond (Fig. 380), but slightly larger, with a thin, fibrous covering, and one of the favorite hosts of the fruit fly. On turning back the covering of one of the nuts there were disclosed to view eleven Mediterranean fruit fly maggots, subsisting on what appeared to be scarcely enough food for one.

Had not these seeds received the rigid inspection given everything from all localities where fruit fly exists, they would undoubtedly have been planted in southern California, and since the fruit fly, when possible, enters the ground to pupate, nothing—had it been carefully planned—could have been so conducive to the establishing in California of the most dreaded and worst known insect pest of fruit and vegetables in the world today; an insect that has the widest range of host fruits of any known, and whose presence in a fruit growing region means devastation and ruin.

COUNTY HORTICULTURAL COMMISSIONERS.

By FREDERICK MASKEW, Chief Deputy Quarantine Officer.

The central quarantine office is mainly concerned with the County Horticultural Commissioners in their capacity as State Quarantine guardians, but the experience of half a life time, spent in the orchards and fields of California—most of the same working in conjunction with the county officials upon local problems—created a lasting feeling of interest and fellowship in all that pertains to the success of their several functions. It is with much pleasure that we have read the press comments of the exhibits made by the Horticultural Commissioners at the county fairs that have recently been held in different parts of this State.

We have long held, and often set forth, that an active working horticultural commissioner was one of the best assets any county could possess, and in our opinion, an annual fair where the most progressive of its citizens are striving to advance the interests of the county, is one good place at which to demonstrate the same, and with an energetic man in charge, it would be difficult for any other county office to rival it in point of general usefulness.

"Horticultural Commissioner." The title itself implies the possible scope of the service of the office to the producers of any county in California. Applied entomology is one of the phases, but the requirements of the position in its broadest sense call for a knowledge of the soils of the locality and their adaptability to the production of specific crops; the best means of maintaining and increasing their productivity and the most economical methods to be employed to make the same fully available; the varieties of different fruits suited to the particular environment as well as the commercial requirements for the same; a working knowledge of the different grades of nursery stock and their relative values, as well as the principles of laying out and planting an orchard and the subsequent general management of the same; and above all, the ability to assimilate technical findings on all these subjects and adapt the most economic ways and means of applying the same to the immediate conditions of his own county.

o

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VOLUME II No. 11

THE MONTHLY BULLETIN

Alfalfa stems showing larvæ and webbing effects of *Mamestra picta*. (Photo by Reeves.)

OF

STATE COMMISSION OF HORTICULTURE

SACRAMENTO, CALIFORNIA NOVEMBER, 1913

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STATE COMMISSION OF HORTICULTURE

November, 1913

THE MONTHLY BULLETIN

VOLUME II No. 11

DEVOTED TO THE DESCRIPTIONS, LIFE HABITS AND METHODS OF CONTROL OF INSECTS, FUNGOID DISEASES AND NOXIOUS WEEDS AND ANIMALS, ESPECIALLY IN THEIR RELATIONS TO AGRICULTURE AND HORTICULTURE.

EDITED BY THE ENTIRE FORCE OF THE COMMISSION UNDER THE FOLLOWING DIRECTORS:

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1913

CALIFORNIA CITRUS CULTURE

BY

DR. A. J. COOK

State Commissioner of Horticulture

(And for many years a close student of all phases of this great industry)

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STATE COMMISSION OF HORTICULTURE

Sacramento, California.

ZEBRA CATERPILLAR.

(*Mamestra picta*, Harris.)

LIBRARY
NEW YORK
BOTANICAL
GARDEN.

Order—Lepidoptera. Family—Noctuidæ.

By E. J. Vosler, Assistant Superintendent, State Insectary.

The zebra caterpillar, *Mamestra picta,* often attracts attention by appearing in considerable numbers in the early fall on alfalfa.

Comstock[1] describes the caterpillar as of a light yellow color with three broad longitudinal black stripes, one on each side and the third on the top of the back. These stripes on the sides are broken by numerous pure white lines. The pupa is of a brownish color. The adult moth has dark chestnut brown forewings and pale yellow hindwings.

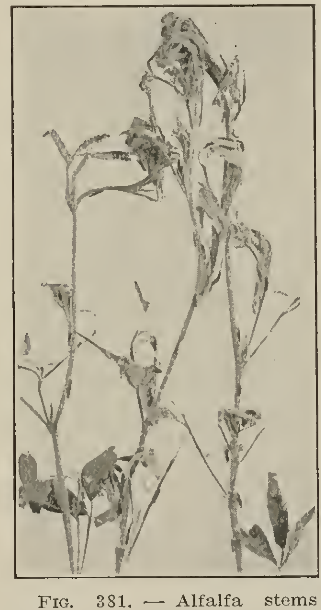

Fig. 381. — Alfalfa stems showing larvæ and webbing effects of *Mamestra picta.* (Photo by Reeves.)

The eggs of this caterpillar are deposited on the alfalfa leaves and hatch in a few days. The young larvæ eat the epidermis of the leaves, which soon appear whitish from their attack. They web the tops of the stalks of alfalfa together, as shown in Fig. 381.

One may go through an alfalfa field and notice here and there plants of which the tops are webbed together and the leaves present a whitish and dead appearance. In the young stages the larvæ work in colonies, and only on the upper and consequently more tender portions of the alfalfa plant. I have seen as many as fifty small larvæ on one leaf and several hundred on the entire plant. As they become larger they will scatter to adjoining plants, eating the leaves as they go. Fig. 382 shows a larva of *Mamestra picta* destroying the leaf tissues of the alfalfa. Often at a radius of several feet from the originally infested plant the larvæ may be found working on the leaves.

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[1] Manual for Study of Insects, page 305.

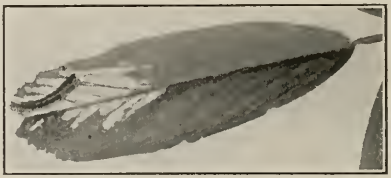

FIG. 382.—Larva *Mamestra picta* on an alfalfa leaf. (Photo by Reeves.)

An interesting note in connection with the feeding habits of this caterpillar was observed in an alfalfa field at Salt Lake, Utah. During the latter part of September and the first of October, when the alfalfa leaves were becoming too tough, the larvæ would migrate to the edges of the field and feed on the tender growth of dock, which was very abundant along the ditch banks. Day after day the larvæ were picked off the dock, and each time a new number of well grown larvæ appeared.

From September to October the caterpillars on becoming full grown enter the soil to pupate. In the breeding cages a majority passed the resting stage at a depth of from 4 to 6 inches. The winter is passed in this stage, the moths appearing in the spring. There are probably several generations, but the last generation in the fall is the one in which the larvæ are numerous enough to attract attention.

At present the best method for the control of this pest on alfalfa is to go through a field picking and destroying infested tops, which are conspicuous because of their whitish color, when the larvæ are in the young stages and consequently massed on one or two stalks. If the fields are pastured at this time of the year very little damage will result from this insect's attack.

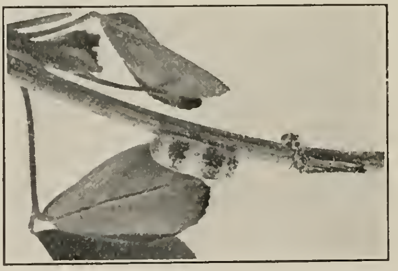

FIG. 383.—Cocoon of *Campoplex* sp. on alfalfa stem with the larval remains of *Mamestra picta*. (Photo by Reeves.)

We have records of this insect occurring in the Atlantic States, Colorado, Utah and California.

Besides alfalfa, it attacks cabbage, celery, beets and other garden vegetables.

Very few natural enemies have been recorded on this caterpillar. An undetermined species of a tachinid fly has been reared from *Mamestra picta*. A species of *Campoplex* of the family *Ichneumonidæ* was reared from the young larva of *Mamestra picta*, at Salt Lake, Utah. The *Campoplex* oviposits in the very young larva and emerges from the host at about the third stage, spinning its cocoon below the host remains. Fig. 383 shows the cocoons of this parasite and the remains of the host.

INJURY AND PROTECTION OF FRUIT FROM FREEZING.

By GEO. P. WELDON, Chief Deputy State Commissioner of Horticulture.

One of the chief limiting factors in the production of fruit throughout the various states of the Union is frost. It is true that there are certain sections of the country where such have seldom or never occurred to the detriment of the fruit crop. Experience of orchardists in California and elsewhere has led to the conclusion that no section, no matter how free it has been from killing frosts during the danger period of trees in the past, can be said to possess immunity, and there may come a time when the temperature will drop so low that buds, blossoms and fruit, if not trees, must succumb. There are, of course, many places where fine fruit is grown during favorable seasons that are visited by killing frosts periodically, and the chances for and against raising a crop are about even. Such sections do not offer the best advantages for commercial orcharding unless some practical means of protecting the crop during the danger period may be employed.

Period of Greatest Danger from Killing Frosts.

In the case of deciduous fruits, the injury is usually done either to the buds, blossoms or small fruit in the early spring, about blossoming time, although a severe freeze during the winter season may kill the buds. In the case of citrus trees, freezing temperatures any time during the winter or spring season may result in the destruction of the fruit, while the buds of well-ripened, perfectly dormant deciduous trees will often stand temperatures ranging from 10° to 30° or more below zero. The period of greatest danger, as far as deciduous fruits are concerned, corresponds pretty closely to the time from when the buds begin to swell in the spring until the fruit (apples or peaches) has reached a diameter of a half inch. This time is, of course, subject to variations in climate, due to altitude or local conditions.

Bud Injury.

Winter or early spring injury to buds may be detected by a discolored area seen in the center upon cutting them open. The pistil or central organ of the blossom is usually the first part to freeze and once frozen fertilization is rendered impossible. Blossoms so injured will sometimes develop, and the trees will come out in blossom and be just as beautiful as if nothing had happened. An examination of such blossoms will show the blackened pistil in the center, and if any fruit develops, it must be from blossoms which escaped this injury or which developed later. A peculiar form of freezing of apple blossoms which has come to my notice in another state destroys the petals entirely. The rest of the parts of the blossom develop normally; fertilization takes place as usual, and a good crop of fruit may set on the trees.

Fruit Injury.

Often fruit develops from frost-injured blossoms, but probably never except when fertilization has taken place prior to the injury. It is a very common thing to find seedless apples or pears during a season following a freeze at blossoming time or shortly afterward. Fig. 384 is a picture taken of two Bellflowers picked from the same tree. One apple is almost true to the type of this particular variety; the other is very much flattened and distorted. Most of the apples in the orchard where these were picked resembled the latter, and it was difficult to find

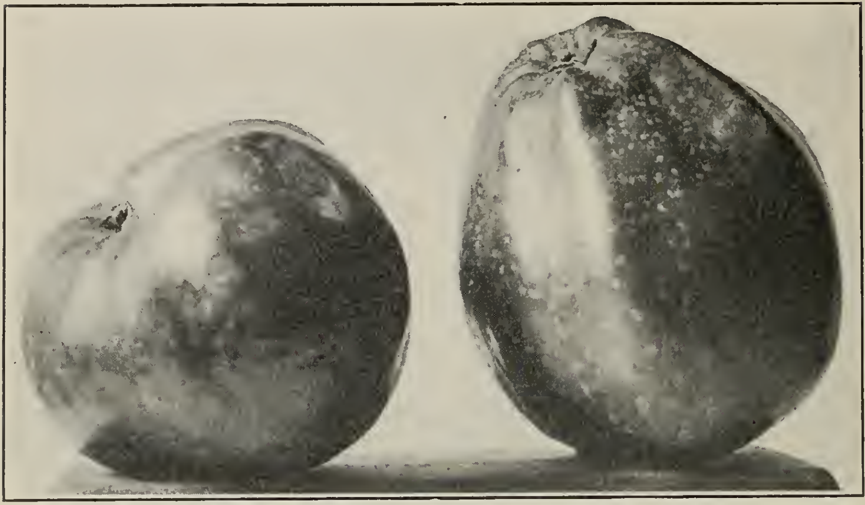

FIG. 384.—Normal shaped Bellflower on right; abnormal Bellflower on left because of frost injury. (Original.)

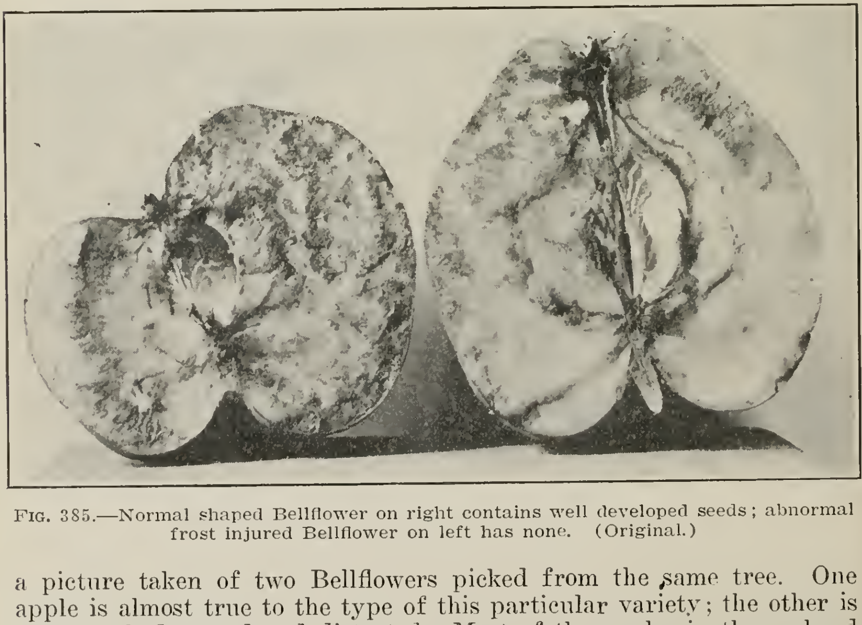

FIG. 385.—Normal shaped Bellflower on right contains well developed seeds; abnormal frost injured Bellflower on left has none. (Original.)

a typical-shaped Bellflower. All apples of this shape were seedless. This trouble might easily be confused with distortion of apples from the attack of purple apple aphis. This pest always leaves the apples small and misshapen, but well-formed seeds are present. Fig. 385 shows the same two apples as in Fig. 384, which have been cut open. A well-developed seed is shown in the core of the typical-shaped apple, while the other one has none. Figs. 386 and 387 show distorted Bartlett pears which were injured by a spring freeze and which have developed no seeds.

Another form of injury to fruit is the so-called frost russet illustrated in Fig. 388. The russeting very frequently shapes itself in a band about the fruit, but in some cases may occur in the calyx and stem cavities. This injury is very commonly confused with that resulting from thrips or blister mite on pears, and scab or Bordeaux injury on both pears and apples and various other things. The presence of the characteristic bands as illustrated is a sure indication of frost injury.

Leaf Injury.

A peculiar crumpling or blistering of the leaves of deciduous fruit always follows severe spring freezes. The epidermis of the leaf may separate from the inside portion wherever these blisters occur. Such leaves are apt to turn yellow and drop very early in the season. This form of injury is not serious.

Susceptibility of Varieties.

Some varieties of apples, pears, peaches, cherries, as the case may be, will stand much more freezing than others. Again, some varieties will blossom much later than others, thus escaping a frost that would injure earlier blossoming varieties. It is, therefore, wise for the orchardist who lives in sections of killing spring frosts to select the hardiest, and in some cases preference should be given to late blooming varieties. As an illustration of this fact the Rome Beauty and Jeniton apples blossom much later than the Ben Davis and Jonathan, consequently often escape injury when the latter-named varieties are killed by a freeze coming about blossoming time.

Frost Protection.

It is safe to say that the orchard which is well cared for in general is less liable to injury from freezing than the one which is neglected. The first point which should be emphasized, then, in connection with protecting the orchard from killing frosts is proper care. Cultivation, pruning, fertilization, irrigation and spraying are all necessary at certain times for the best development of trees, including the fruit buds. If the buds can go into the winter in perfect condition, there is every reason to believe that they will stand more than they would if devitalized because of unhealthy trees.

Smudging.

It has long been known that there is little danger from killing frosts on a cloudy night. This fact has led to a belief that the same protection afforded by the clouds can be produced artificially by means of smoke. With this idea in view, various materials which in burning will produce much smoke have been burned in orchards during frosty nights. This method of protection is known as smudging, and is fast giving way to the better method of heating. It is probable that light frosts have been warded off by means of such smudges, or at least a sufficient blanket has been formed over an orchard in the early morning to prevent the rapid thawing of the blossoms which, if thawed out too rapidly, are sure to be killed. It is now thought that smudging in itself is of little value, and many of the successful orchard heaters now in use are designed to utilize as much of the fuel as possible; the more complete the combustion the better they are thought to be.

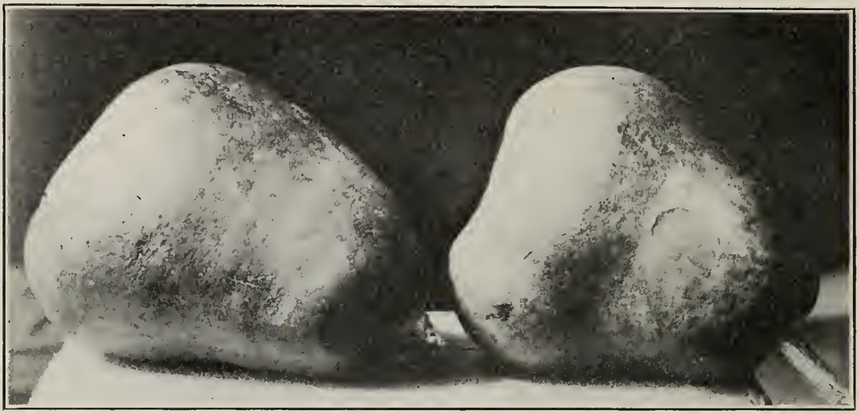

FIG. 386.—Poorly shaped Bartlett pears injured by freezing. (Original.)

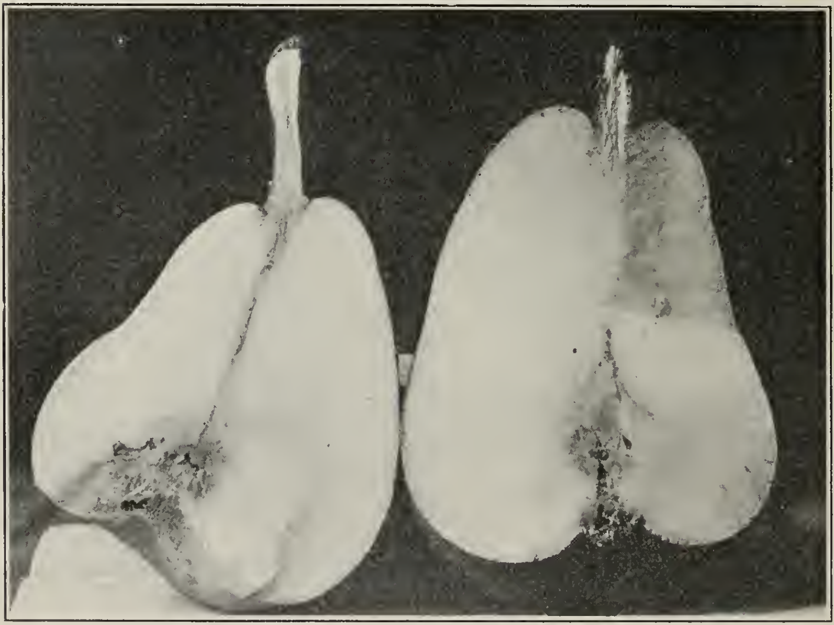

FIG. 387.—Pears shown in Fig. 386 cut open to show that they are seedless. (Original.)

Orchard Heating.

While there are still many problems in connection with orchard heating yet to be solved, it is now generally conceded that, under certain conditions at least, a crop of fruit, citrus or deciduous, can be saved, even though the temperature falls as much as 15° below freezing. During spring freezes of four different seasons in Colorado, the writer had abundant opportunity to study the various operations of the orchard heating business in time of action, and the effect of such heating in saving fruit. The first practical demonstration of what could be accomplished was made in the spring of 1908. Three or four different parties had previously purchased some of the Bolton orchard heaters, which at that time were manufactured in California. By the use of these small lard-pail pots, as they were called, which held about three quarts of oil, these men succeeded in saving a considerable amount of fruit. The demonstration was a perfect one, for only in the heated areas was there any fruit. Before this time there were orchards in California where heaters had been used. The Limoneira Company had done considerable work along this line, and had used wire baskets for burning coal with more or less success. The fact that it was possible to save a crop of fruit by burning coal or oil in containers led to the making and patenting of a great many types of heaters, practically any one of which will do the work, provided that the necessary amount of fuel is burned. Both coal and oil have given satisfaction, but the latter is preferred by most orchardists. In California, where oil is so cheap and coal so high, it does not seem as though any one would be justified in purchasing coal heaters. It would not be policy to recommend any particular make of heater in this article. In general, the reservoir type of oil heater is the most satisfactory. One can scarcely afford to purchase heaters and other equipment for the work and then fail because of an insufficient supply of oil. Of course, it is possible to refill small heaters, or to have a reserve supply of them on hand, but such entails extra work and expense at time of heating when it is often hard to get enough help.

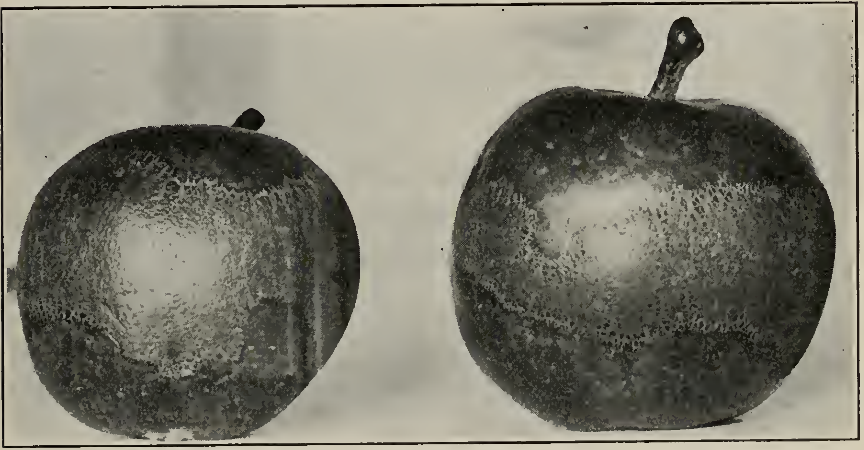

FIG. 388.—Frost russet band of apples. (Original.)

Placement of Heaters in Orchard.

One heater for each tree is the number ordinarily used. They are commonly placed in the center of the rectangle formed by four trees.

When to Light.

Firing should begin before the temperature has reached the danger point, the object being to keep it at a certain point rather than to let it drop below and then try to raise it again. For example, it is much easier to maintain a temperature of 32° when the outside temperature is 25° than it is to raise it to 32° after it has dropped down to 25°. While fruit buds or blossoms may stand this temperature for a short time, it is never safe to let it get so cold.

Keep Firing Well After Sunrise.

Many a crop of fruit has been lost because fuel played out, or because men became tired or careless and let fires go down at daybreak. The coldest period is very often about sunrise and the heaviest firing is necessary at this time.

Use Only Tested Thermometers.

To depend upon a twenty-five cent thermometer in the orchard-heating business, when thousands of dollars are at stake, is inexcusable foolishness, and yet such has often been done. Nothing but reliable, tested thermometers should be used in this important work. Several should be used and placed in different parts of the orchard, as there may be quite a temperature variation in a short distance. Electric alarms may be used, but it is more satisfactory in actual practice to have reliable men to watch the thermometers and record temperatures every few minutes during the time of expected freeze.

Success Means Hard Work.

Our present knowledge of frost fighting with orchard heaters is not such that it can be recommended under all conditions. With the temperatures that we usually have during the period of spring and winter freezes in California, it is safe to say that the man who is willing to observe all the details and who is not afraid of the hardest kind of work will succeed. Not every man who has orchard heaters does, neither does every man who sprays make a success of that operation. Orchard heating, if it is done at all, should be done rightly, or else all labor and expense may be thrown away. No one who is looking only for the easy jobs should have anything to do with this work.

REPORT OF DOCTOR G. HAROLD POWELL, MANAGER OF THE CALIFORNIA FRUIT GROWERS' EXCHANGE.

By A. J. Cook, State Commissioner of Horticulture.

This report is full of encouragement. It shows the value of this great co-operative association, demonstrates completely success in what was at first thought to be a most serious calamity, and must give to all citrus growers renewed courage.

The estimated crop at the beginning of the year, September, 1912, was thirty-four thousand carloads, or 13,250,000 boxes. Never before was the estimate so large.

The heavy November winds destroyed ten per cent of the crop, and the unprecedented freeze of January, 1913, still further reduced it, so that only 12,445 carloads were sent to market. We see by this that over 60 per cent of the crop was destroyed.

This colossal misfortune was heralded throughout the country, and without the Exchange the showing given in this report would not have been possible.

As a result of the double loss, only 37 7/10 per cent of the estimated shipment for the year was sent to market by the Exchange. This amounted to 61⅓ per cent of the total shipment from the State during the season. Indeed, it surpassed the percentage of any previous year. In 1905 the Exchange marketed only 47 per cent of the total crop, but has speedily increased from that time until now.

The freeze of course resulted in a shortage of citrus fruits, and so prices ruled high. The cash returns exceed $13,500,000, an average of $2.75 per box. This is 50.2 per cent higher than the average for the past eight years.

It will be remembered that Mr. Frank F. Chase, of Riverside, discovered a method of segregating the frozen and unfrozen fruit. It is a gratifying fact that only one third of one per cent brought ''red ink'' returns. Notwithstanding the great freeze, 98.25 per cent brought a cash return after all expenses were paid. The one third of one per cent were probably those sold immediately after the disastrous frost.

The total cost of marketing each box of fruit the present season was 7⅓ cents, or only 2 per cent of the gross sales. This is 16 per cent less than that of the previous year, owing to better prices this present season. Surely, farmers can do business. This, however, is only the cost of maintaining the central exchange. If we add the cost of maintenance of the district associations, the entire cost is less than 2⅜ per cent of the gross sales. Doctor Powell adds that this is less than the cost of marketing any agricultural product in America other than this. The usual cost is not less than 5 per cent and more often reaches 10 per cent or even more.

The total losses during the year from bad debts, etc., were $380.70, or less than 1/333 of one per cent, of the cash returns to the growers. Since 1904 the net returns paid by the Exchange to growers has been $131,000,000; the total losses $5,731.21, or less than 1/200 of one per cent. Does this not show that farmers can do business? Co-operation has won out.

The shipments this season after the disastrous freeze were 53 per cent of those of the previous year, and the f. o. b. cash proceeds 79 per cent. After deducting all expenses of whatsoever kind, the growers received 85 per cent of the amount paid them the previous year. The f. o. b. average price this season was 47 per cent above that of last season. So well was the business conducted by the Exchange that though the amount of fruit sold was so greatly reduced, yet the cost to the growers was only ¾ of a cent per box above that of last year.

A SERIOUS PHILIPPINE ORANGE MOTH.

Prays citri Mill.

(*Prays nephelomima* Meyrick.)

By E. O. Essig, Secretary State Commission of Horticulture.

Prof. C. F. Baker[1] continues to show his keen interest in the protection of California horticulture by his many reports to the State Commission of Horticulture relative to the serious insect pests in the Philippine Islands, which should be intercepted in quarantine. Of all enumerated, he has called particular attention to a small moth, concerning which he writes: "The little moth works in a variety of native orange here, called the 'cajel.' It practically makes a gall in the rind, causing a tumor-like swelling that is always open at the outside, and which does not seem to penetrate the pulp at all. I get large and small moths from these galls. It is apparently a new pest of oranges and seems to be widely distributed, and should be taken account of in quarantine work. The determination, *Prays citri* Mill., of which *Prays nephelomima* Meyrick is a synonym, came through Busch from Meyrick himself."

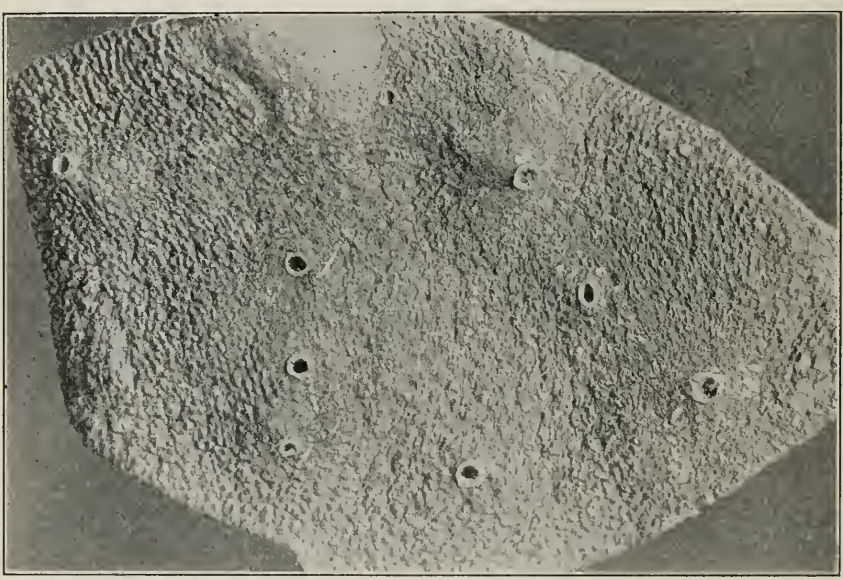

Fig. 389.—Rind of "cajel" orange showing tumors made by the larvæ of *Prays citri* Mill. Twice enlarged. (Original.)

The larvæ of this moth live just beneath the rind next to but not in the pulp. They produce gall-like tumors, which remain opened at the tips. (Fig. 389.) These tumors are often exceedingly numerous and may almost cover the entire surface of the orange. Both the appearance and keeping qualities of the fruit are thus destroyed, as the openings are very repulsive to the sight and afford excellent germinating places for destructive fungi, which are always abundant. The tumors are often scarcely perceptible in height, while many protrude one fourth of an inch. The opening is usually about one eighth of an inch in diameter. The larvæ are small, rarely attaining a length of more than one fourth of an inch. They are light yellow or whitish, and have the head, two small spine areas on the dorsum of the prathorax, two similar areas on each of the mesothorax and metathorax, and the tip of the abdomen dark brown. The body is covered with many colorless hairs, which are not visible to the unaided eye.

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[1] Professor of Agronomy, College of Agriculture, University of the Philippines, Los Banos, P. I.

The adult moths,[2] as previously stated by Prof. Baker, are of two distinct sizes, the largest being three eighths of an inch long and the smaller about half as large. The general color is light grayish-brown, with large and distinct dark marking upon the front wings. The body, legs and antennæ are light, as are the hind wings, which have large marginal fringes. Under certain lights there is a bright blue iridescence to the color of the wings and body.

As there is apparently no way of importing this pest except with the fruit, the danger of introducing it to California is greatly reduced by the quarantine laws which are being maintained against all countries where the fruit flies (*Trypetidæ*) are known to exist. However, the recognition of such a pest by quarantine inspectors may prevent its introduction from some other section of the world where these laws do not apply.

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[2] The material from which these descriptions are made was furnished by Prof. C. F. Baker.

GENERAL NOTES.

AN INTERESTING INTRUDER.

When we remember that there are more insects, probably more beetles (*Coleoptera*), than there are of all other species of animals of all the groups, we may not wonder that the student of this class of animals is constantly running against surprises. An insect puzzle has just come to us here. Mr. S. H. Essig, Horticultural Inspector of Ventura County, sends in a large number of snout beetles, or weevils, which were found doing no little damage to the tender foliage of the apricot trees. These prove to be otiorhynchids, or not very distant relatives of Fuller's rose beetle, *Aramigus fulleri*. This, strange as it may seem, is a species entirely new to science, so far as we can determine. The puzzle is just here: How could a new species come upon us all at once in large numbers? Is it an importation, or has it come upon the apricot from some wild plant of our own State? In either case we should suppose that some keen-eyed entomologist would have "spotted" it before this.

It will be remembered that Fuller's rose beetle was discovered only a comparatively short time ago. Yet it is now a pest to be reckoned with, both as a larva and as an imago.

Fortunately this new pest does not come till midsummer, when the season's growth is well advanced, and so partial defoliation is less damaging than earlier in the season.

The larvæ of *Aramigus fulleri* feeds upon the roots of roses, raspberries, blackberries and other rosaceous plants, and often does serious mischief. It will be interesting to know where this new pest works in the larval or grub stage.

A word as to remedial measures against this new pest. In case the larva works on the roots of cultivated plants then bisulphide of carbon, which has been used successfully against the grubs of Fuller's rose weevil, would doubtless serve as a remedy. It is a well-known fact that most weevils when jarred fall to the ground, and that all leaf-eaters are poisoned by use of lead arsenate as a spray. By use of the jarring method—trapping the insects—I saved my plum crop in Michigan entirely for years, while neighbors who gave no heed to the Curculio lost all. Lead arsenate, three pounds to fifty gallons of water, is a cheap, effective poison. This is a mixture and not a solution, and so should be stirred so as to keep it uniform. In case insects are very numerous, this last may seem to be ineffective, as the multitudes killed by the poison are at once replaced by other multitudes ready to take their place and meet their fate.

This often happens when we use the arsenical mixtures to kill the rose chafer, *Macrodactylus subspinosus*, of the eastern states. In all such cases, where we use poisonous sprays, we must apply with force so as to reach all the foliage.—A. J. Cook.

A NEW METHOD OF DESTROYING WOOLLY APHIS.

M. A. Cadoret, of France,[1] has discovered a new method of destroying woolly aphis on fruit trees. It consists in painting the attacked parts with a mixture composed of:

Linseed oil	7	pounds
White lead	1½	pounds
White zinc	1	pound
Turpentine	1	pound

Boil together the first three for ten minutes and allow to cool, after which add the turpentine and apply with brush in spring and autumn.

In many sections where large knots are produced by this pest, it might be well to give this method a trial yet this year.—E. O. Essig.

THE ROSE APHIS.

In the Review of Applied Entomology, Series A, Vol. I, Part 8, page 271, 1913, there is a review of some experiments on the rose aphis, conducted by T. Peneau in France. He calls particular attention to the destruction of the eggs in winter by painting the stems with lime or with a mixture of quicklime 5 parts, sulphate of iron 3 parts, water 50 parts (all by weight). A mixture which he claims is better than either of the above is called Melange de Balbiani, and is made as follows: Dissolve 7 pounds of naphthaline in 5 pounds of coal tar; add 24 pounds of slaked lime; gradually add water until there are 10 gallons of spray. These materials are applied in June.

It might be well to experiment with the last spray as a means of destroying the eggs of the rosy and green apple aphids, which are so serious in California.—E. O. Essig.

THE WATSONVILLE APPLE SHOW.

The exposition at Watsonville, October 6th to 14th, was a pronounced success. The pageantry feature was strikingly attractive; the feature exhibits most original, very ingenious and, like the pageants, must have required days of hard work. These were in the hands of the school children of the county, and the writer has rarely, if ever, seen anything to equal them. The wholesome attractions other than the exhibits warranted the exceptionally large attendance.

A noticeable reform over the exhibit of last year was the omission of carload lots. Is it not much more important to exhibit single boxes, five- and ten-box displays, as these attract the attention of the small grower and growers rather than of the dealers?

Messrs. Rowe of Michigan and Olwell of Rogue River Valley, Oregon, who acted with the writer as judges at the Exposition, commented very favorably upon the quality of the fruit. Mr. Rowe, who has acted as judge at all of these Watsonville expositions, stated that there was a marked improvement each year, which gives clear warrant to such exhibitions, costly though they may be in time and money.

Two peculiarities of this Apple Show are most interesting: One, the splendid apples coming from our mountain counties where the altitude is high and the winter temperature low. Especially fine was the exhibit from Inyo County. One of the judges remarked that everything in that exhibit should take a prize. The display from Humboldt County was also greatly admired. Second, the diversity of products which we can get almost in any county of California.

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[1] Rev. Appl. Ent. Vol. I, Ser. A, Part 8, p. 274, Aug., 1913.

In an automobile drive we noticed some of the orchards excellently well-cultivated; others, not so. These last, with a large growth of weeds, were certainly losing great quantities of water, carried off by transpiration, which they could illy afford to lose.

Evidently many props had been used to hold up the great crop and to prevent breaking of branches. Would not more attention to pruning and thinning of fruit do away with this necessity of using props, and so permit cultivation and destruction of weeds?

It is certainly true that this year's display of exhibits at Sebastopol and Watsonville fully demonstrates the value of such expositions.—A. J. Cook.

TWO SPRAY FORMULÆ FOR FRUIT FLIES.

In the work of controlling the olive fruit fly in France, S. Scelsi[1] gives two important spray formulæ which have become very noted in that country, and which may prove of value in the control of the few fruit flies known in this country. They are as follows:

Berlese Formula.

Molasses	20 pounds
Arsenate of potash	4 pounds
Water	20 gallons

De Cillis Formula.

Molasses	130 pounds
Honey	62 pounds
Glycerine	4 pounds
Arsenate of soda	4 pounds
Water	20 gallons

The spraying should be done thoroughly, great care being taken to see that all of the leaves are wet.—E. O. Essig.

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[1] Review of Applied Ent. Vol. I, Ser. A, Part 8, p. 271, Aug., 1913.

SOME INTERESTING FRUIT FLIES.

Prof. C. F. Baker has made some remarkable discoveries in the Philippine Islands with regard to fruit flies, which are worthy of note here. The melon maggot, *Dacus cucurbitæ* Coq., is abundant there. *Dacus ferrugineus* Fab., as has been previously reported there, proves to be *Dacus ferrugineus* var. *pedestris* Bezzi. The most interesting fly, the maggots of which he found swarming in wild oranges, proved to be a new genus and a new species which Bezzi named *Monacrostichus citricola*.

Prof. R. W. Doane, of Stanford University, has recently collected the Queensland fruit fly, *Dacus zonatus* Coq., on the Island of Tahiti.

Specimens of all the above species are in the collection of the State Commission of Horticulture.

All of these fruit flies are serious pests, so these records are of great value to the horticultural quarantine departments of the state work.—E. O. Essig.

CALIFORNIA NURSERYMEN'S CONVENTION.

The meeting of the California Nurserymen was well attended, and the program very interesting and instructive. One rarely listens to so excellent a program.

The large attendance of county horticultural commissioners was very gratifying. The mingling of these commissioners, the fruit growers and the nurserymen, will tend toward that harmony of thought and feeling which is indispensable to the best practice.

We have only to know our Californians in each of these classes to feel sure that any want of accords results from lack of acquaintance. Such meetings will aid greatly to secure uniform horticultural laws, ordinances and practice.—A. J. COOK.

FORMULÆ FOR PRESERVING FRUIT.

The specimens to be preserved should be the most perfect obtainable, free from all blemishes and imperfections. In most cases fruit of a fair degree of ripeness is better than partly green specimens.

Exhibition jars should be of clear, white glass, preferably with ground glass stoppers. The tall cylindrical form is desirable, especially for the smaller fruits.

The sorted fruit is first carefully placed in the jar, which is then filled with clear water. After standing a short time, the water should be poured off, so as to remove all particles of dirt from the jar and contents. The jar may then be filled with the preserving fluid and kept in a dark, cool place until the time for exhibition. Frequent examination should be made to determine how well the fruit is keeping. If the liquid becomes colored from the fruit, it should be poured off and replaced by fresh fluid.

The following formulas have been successfully used at the Colorado Agricultural College, especially with plums, grapes, cherries, currants and gooseberries:

Formalin, 5 parts; saturated solution of common table salt, 10 parts; water (boiled and cooled) enough to make 100 parts. This may be made up by measures as follows: Formalin, 1 pint; salt solution, 2 pints; water, 17 pints.

When made up, the solution will keep indefinitely. Another solution weaker in formalin has also been used here satisfactorily. The proportions are: Formalin, 3 parts; salt solution, 10 parts; water enough to make 100 parts.

For raspberries, the following mixture is recommended: Formalin, 1 part; glycerine, 10 parts; water, 89 parts. Strawberries may be preserved fairly well in a saturated solution of common salt, and, better still, in a fluid composed of formalin, 1 ounce; alum, 1 drachm; glycerine, 5 ounces; water, 3 pints.

Red currants keep best in a solution of corrosive sublimate, 1 part; glycerine, 10 parts; water, 90 parts.

The corrosive sublimate must be dissolved in hot water and the solution and fruit preserved in it should be labeled poison, as it is very deadly if swallowed.

The glass stoppers of bottles and jars may be made perfectly tight by smearing the ground surface with a small amount of light colored vaseline. This will also prevent, in great measure, the sticking of the stoppers when it is desired to remove them.

CITRUS CROP ESTIMATE.

The following estimate for the citrus crop has been received from G. Harold Powell, manager of the California Fruit Growers' Exchange, under date of November 4, 1913:

The estimates or oranges and lemons made by the Exchange shippers at all of the different shipping points indicate a crop for the State of 38,000 to 40,000 carloads. This estimate would, of course, be changed one way or the other, depending upon climatic conditions from now on. The indications are, however, that there will be about 33,000 or 35,000 cars of oranges and approximately 4,500 cars of lemons. Of the oranges, these preliminary estimates show about 8,000 cars of Valencias and 23,000 to 25,000 cars of Navels. There are usually from 1,500 to 2,000 cars of other varieties of oranges. Of course these estimates are preliminary, but they are based on accurate individual estimates of the growers in the different sections.

SPRAYING TO CONTROL TOMATO THRIPS.

In the report of the Florida Agricultural Experiment Station for 1912, issued March, 1913, pp. 61–62, R. T. Watson has published some interesting things regarding spraying for the tomato or grain thrips, *Euthrips tritici* Fitch. He found that the majority of the tomato blossoms, instead of setting fruit, turned yellow, and if touched dropped off at the node. When these were opened they were found to contain six or more thrips apiece. The pistils and stigmas were attacked. Eggs were found in the style and pedicle, and there was no doubt but that the dropping was caused by the thrips. A trial piece was treated with a spray composed of:

Commercial lime-sulphur (33° Baumé)	5½ gallons
Black-leaf "40"	14 fluid ounces
Water	200 gallons

Seventy-eight per cent of the thrips were killed.—E. O. Essig.

CALENDAR OF INSECT PESTS AND PLANT DISEASES.

By E. J. VOSLER, Assistant Superintendent of the State Insectary.

[Under the above heading the author aims to give brief, popular descriptions and methods of controlling insect pests and plants as near as possible just prior to or at the time when the suggestions given should be carried into effect by the growers.]

KILLING THE SQUASH BUGS.

The squash bug is a brownish-black insect with yellow spots along the edges of the abdomen and has a dirty yellow venter. The young of this bug, which hatch from eggs deposited by the adult in the spring on the early sprouts of squash and pumpkin vines, attack and destroy the young tissues of the plants. As this bug winters over in the adult stage under rubbish and among the old vines, clean culture is important. At this time of the year the burning of all rubbish in the fields, especially the old vines, cleaning along fences and fall plowing, will greatly aid in the reduction of this pest the following year.

INSECTS IN STORED PRODUCTS.

There are many species of insects which do much damage to stored products. Among these can be mentioned the grain weevils, pea weevils, the flower moths, etc. Use carbon bisulphide against these pests, the vapor of which, being heavy, will go downwards, penetrating the stored material to be fumigated. A tight fumigating room is an essential. Pour the carbon bisulphide into shallow dishes and place in the bins, using five pounds to one thousand cubic feet of space. As this fumigant is highly inflammable, caution must be taken that it is not placed near flames. The temperature should be 70° Fahr. or above to insure the best results. Leave products in the room about twenty-four hours.

INSECTS IN GREENHOUSES.

Two pests very troublesome in greenhouses are the red spiders and the mealy bugs. The former cause the affected leaves to turn yellow and drop. They are noticed as small reddish dots on the under sides of the leaves. Syringing the plants forcibly with water two or three times a week, care being taken to reach the undersides of the leaves, will usually suffice to keep this mite under control. The mealy bugs are probably the hardest pests to fight in the greenhouse. Syringing, as used against the red spider, is the most practical remedy, but will be effective against the younger stages only.

THE FRUIT TREE LEAF-ROLLER.

The larvæ of the fruit tree leaf-roller injure the blossoms and destroy the fruit and foliage of many species of plants, including apple, pear, plum, cherry, apricot, quince, peach, rose, currant, raspberry and gooseberry. This insect passes the winter in the egg stage. The egg masses are made up of from ten to one hundred and fifty eggs covered with a sticky substance deposited with the egg. They are laid most anywhere on the bark of shade trees, fruit trees, shrubbery and berry bushes.[1] George P. Weldon recommends the use of soluble oils used in proportions not weaker than one gallon of soluble oil to nineteen gallons of water as a winter spray to destroy the egg masses of this pest.

THE CALIFORNIA TUSSOCK MOTH.

The caterpillars of this moth are gray in color with numerous colored spots. They have four prominent white tufts on the dorsum and two distinct black ones on the head. They feed upon the young fruit and foliage. As this pest spends the winter in the egg stage, the hand picking of the egg masses after the leaves have fallen will greatly reduce their numbers. The egg masses are attached to the trunks of trees and to nearby objects or to twigs.

PEAR BLIGHT.

The damage wrought by pear blight and the appearance of affected trees are too well known for comment in this article. Suffice it to say that during the winter months the orchard should be carefully gone over and the diseased portion of the trees cut off and burned before the blooming season commences. The prunning tools and the cuts must be disinfected with corrosive sublimate 1 to 1000. Care must be taken to cut off below any sign of the visibly infected area. If after this treatment blight appears during the growing season, the work of cutting out infested areas must be continued.

SMUT OF WHEAT, OATS AND BARLEY.

The smut of grains causes large losses annually to the agriculturist in the United States. Sprinkle the grain thoroughly with formalin, 1 pint to 30 gallons of water, and allow the seed to dry before sowing.

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[1] Mo. Bul. Cal. State Com. of Hort., Vol. 2, No. 9, p. 645.

INSECT NOTES.

Conducted by the Editor.

Mr. C. W. Beers, of Santa Barbara, reports a **millipede** doing considerable damage to the tender roots of vines in his county. Mr. B. R. Jones also reports this worm and has sent in specimens of lettuce heads from Los Angeles County which are badly damaged by this millipede. These worms are more commonly called the thousand-legged worms, and are, for the most part, considered harmless, feeding largely upon decaying vegetable matter and only occasionally attacking living roots.—LEROY CHILDS.

From Philo, Mendocino County, Cal., comes the report that the **dark blue blister beetle,** *Cantharis stygica* Lec., is doing considerable damage to buds and blossoms of asters, completely ruining them in many instances.—LEROY CHILDS.

The red-humped caterpillar, *Schizura concinna* S & A, has been reported attacking the foliage of apples, prunes, cherries, pears and walnuts at Modesto.—LEROY CHILDS.

A very curious insect has been reported from Los Angeles, parasitic upon pigeons. It proves to be one of the little known parasitic flies belonging to the family *Hippoboscidæ*, and is reported as annoying the birds very much. These insects occur occasionally on wild birds, such as owls, partridges and quail, but to the writer's knowledge have never been reported as annoying any domestic fowls.—LEROY CHILDS.

Currant and gooseberry fruit fly, *Epochra canadensis* Lœw., was received from Geo. A. Lamiman, Anderson, Shasta County, Cal., September 29, 1913.

The walnut scale, *Aspidiotus juglans-regiæ* Comst., has been recorded as present on walnut trees in the Anaheim section of Orange County by Roy K. Bishop, who states that limbs are evidently killed by it.

Black scale, *Saissetia oleæ* Bern., badly infesting watermelon vines, have been sent in by Roy K. Bishop, and with them the following data: "These vines were raised between two rows of 3-year-old orange trees. Infestation began June 15th, the black scale hatching at that time. The scale have come to maturity in four months on the watermelon vines, yet on orange trees it is very hard to find living scale, and those found are still very small. Note how much faster they grow on the melon vines than on orange trees." A similar condition was observed by the writer at Santa Paula in 1910. In this instance the melons were also infested. On many succulent plants, such as nightshade, geranium, ivy and melon vines, this scale matures in a very short time.

Mr. R. S. Vaile has recently reared from *Aspidiotus hederæ* Vall., *Aspidiotiphagus citrinus* Craw., and *Aphelinus fuscipennis* Howard, which were kindly determined by Dr. L. O. Howard. This is the first time, to our knowledge, that these parasites have been recorded as working on this scale insect.—E. J. VOSLER.

Chelonus shoshoneanorum Vier., is the name of a parasite reared by Mr. H. A. Weinland, of San Diego County, from the potato tuber moth, *Phthorimæa operculella* Zeller. This parasite was determined by Mr. P. R. Myers of the National Museum through the kindness of Dr. F. H. Chittenden of the U. S. Bureau of Entomology.—E. J. VOSLER.

The State Insectary has just received two lots of mealy bug parasites from Japan through the kindness of Mr. S. I. Kuwana, Entomologist of the Imperial Agricultural Experiment Station, Tokio, Japan.—E. J. VOSLER.

Harry S. Smith, Superintendent of the State Insectary, is now in the Philippine Islands collecting parasites of the black scale and the citrus mealy bug. He recently sent over a fine lot of black scale parasites from this locality.—E. J. VOSLER.

The State Insectary is greatly indebted to Mr. C. H. T. Townsend, director of the Peruvian Entomological Stations, for a colony of black scale parasites.—E. J. VOSLER.

NOTES FROM THE COUNTY COMMISSIONERS

By Geo. P. Weldon, Chief Deputy State Commissioner of Horticulture.

Imperial County.

Mr. F. W. Waite has been appointed Horticultural Commissioner for Imperial County to succeed Mr. W. E. Wilsie, who resently resigned.

Humboldt County.

Humboldt County's resources were splendidly advertised by County Horticultural Commissioner George Weatherby at the California Apple Show recently held at Watsonville. Mr. Weatherby is alive to the opportunities as well as the needs of his county, and is to be commended for the splendid display of products that was made.

Santa Barbara County.

In authorizing County Horticultural Commissioner C. W. Beers to purchase a good power sprayer to use in his work, the board of supervisors of Santa Barbara County are setting a good example for other counties, whose commissioners have no facility for spraying, to follow. Lack of equipment is a serious handicap in field work, and nothing can be put to more practical use than a good spray outfit.

Messrs. Marchbank, Schulz, Schell, Morris, Sharp and Stabler represented their respective counties at the State Nurserymen's Convention held in Fresno recently. The three first mentioned took part in the program.

QUARANTINE DIVISION.

By Frederick Maskew, Chief Deputy Quarantine Officer, San Francisco, California.

The real battle of the human species for the possession and enjoyment of the earth has resolved itself into a universal continuous fight against insect pests. In Continental as well as Island America, the medicos are having a never-ending conflict with mosquitoes, flies and bacilli. The work and triumphs of the sanitary officers in the canal zone are almost equal to those of the engineering staff. The Marine Health Service is constantly at war with the rats and squirrels, but the prime purpose of the combat is directed against the disease-bearing insects that infest these rodents. The world-wide inspection for and control measures against cattle ticks is maintained as much, if not more, in hopes of reducing the ultimate cost of shoes than to augment the comfort of the animal that wears the hide, while the boll-weevil influences the cost of calico in common with the operations of the speculators in cotton futures. If the maggot fly pest of sheep could be eliminated from the flocks of the world, the fabric most in vogue among the proletariate would be all wool and a yard wide, rather than shoddy, and the mysteries of schedule K would probably cease to be of interest.

In our own particular domain we are concerned principally with the insects and diseases hostile to the maximum production of food plants—especially the fruit-flies—and the strict administration of such laws and regulations as provided for their exclusion from the fields and orchards of California by the State and Federal governments. This, in itself, is an undertaking that demands eternal vigilance at our maritime ports of entry with the ever-increasing commerce from the ports of Oceanica and those of the Orient and Central America. But we have not overlooked the importance of the interior points open to the entrance of these pests, and have hopes of ultimately unifying both the system and methods of applying all the provisions of the state quarantine law in the matter of horticultural imports throughout the entire State.

REPORT FOR MONTH OF SEPTEMBER, 1913.

SAN FRANCISCO STATION.

Horticultural imports.

		Parcels.
Ships inspected	41	
Passed as free from pests		61,530
Fumigated		1,848
Destroyed or returned		200
Contraband destroyed		21
Total parcels horticultural products for the month		63,599

Horticultural exports.

	Parcels.
Inspected and certified	4,004

Pests Intercepted.

From Honolulu—

Live larvæ of *Dacus cucurbitæ* in cucumbers.
Live larvæ of *Ceratitis capitata* in string beans.
Cryptorhynchus batatæ and lepidopterous larvæ in sweet potatoes.
Diaspis bromeliæ and *Saissetia nigra* on pineapple slips.
Coccus hesperidum and *Saissetia nigra* on betel leaves.
Pseudococcus sp. and *Diaspis bromeliæ* on pineapples.

From China—

Pseudaonidia trilobitiformis, Chionaspis citri, Lepidosaphes beckii and *Phomopsis citri* on pomelos.

From New Zealand—

Chionaspis sp. on fronds of Tree ferns.

From Tahiti—

Morganella maskelli on oranges.

From Mexico—

Chrysomphalus aurantii and *Lepidosaphes gloverii* on limes.
Tetrapriocera longicornis, Amphicerus punctipennis and *Scolytidæ* sp. in material used as crates for panoche.

From Corinto—

Ant sp. on orchids.

From Philadelphia—

Aspidiotus lataniæ, Pseudococcus citri, Chrysomphalus aonidum and larvæ of *Thrips* sp. on palms.

From New York—

Diaspis boisduvalii on orchids.

LOS ANGELES STATION.

Horticultural imports.		Parcels.
Ships inspected	22	
Passed as free from pests		16,251
Fumigated		5
Destroyed		0
Returned		0
Contraband		0
Total parcels horticultural products for the month		16,256

Pests Intercepted.

From Florida—

Chrysomphalus aurantii, Coccus hesperidum and *Parlatoria* sp. on mango trees.

From New Jersey—

Parlatoria pergandii on crotons.
Saissetia hemisphærica on ferns.

From Pennsylvania—

Chrysomphalus aurantii on palms.
Coccus longulus and *Parlatoria* sp. on crotons.

SAN DIEGO STATION.

Horticultural imports.		Parcels.
Ships inspected	23	
Passed as free from pests		2,124
Fumigated		3
Destroyed		0
Returned		0
Contraband		8
Total parcels horticultural products for the month		2,135

Pests Intercepted.

From Arizona—

Bruchus sp. in "screw-beans."

From New York—

Monophadnoides rubi in black raspberry canes.

SANTA BARBARA STATION.

Ships inspected ---------- 1
No horticultural imports.

EUREKA STATION.

Ships inspected ---------- 4
No horticultural imports.

UNIFORM HORTICULTURAL LAWS.

By Frederick Maskew.

During the past month a number of earnest men have again been striving to bring about a system of uniform horticultural laws. The writer of this was not present in this instance, but it has been his fortune to have attended many such meetings during the past sixteen years, at all of which much time, thought and discussion were devoted to this same subject, yet little of a positive satisfactory nature was accomplished. During all of this same period we have been almost daily engaged in putting into execution the provisions of such horticultural laws and regulations as were in force at the time, and have of a necessity given much thought to the matter. As a result of this, it is our opinion that the principal barrier to success is the ambiguous nature of the certificates of inspection issued. When those interested in this much needed standardization of interstate horticultural regulations can bring it about that each certificate of inspection covering a consignment of horticultural material shall be virtually an affidavit of known facts and not a supposition, the foundation will have been soundly laid, and the superstructure of design, acceptance, respect and uniformity of interstate horticultural regulations will quickly follow.

Under the conditions that prevail in many of our states at the present time, it is a physical impossibility to conduct the inspection in such a manner as to make certificates of inspection acceptable at their face value in California. To go into the details of why this is so would fill this volume; suffice it to say, the true cause at the present time is the inadequate inspection force employed. The men composing the horticultural inspection service in California are endowed with robust minds. They look at the fundamental principle underlying this inspection work in a practical utilitarian spirit and with a full realization of the equity of every phase of the situation. The numerical strength of the combined State and county inspection force in California makes possible a thoroughness not obtainable in many other localities, and as a result creates a feeling of disgust for fictitious or fallacious statements of inspection. It is our opinion that the true cause for this feeling must be permanently removed before a full measure of support and co-operation in constructive legislation upon these matters can be obtained from the rank and file of the horticultural inspection service of the State of California.

o

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VOLUME II No. 12

THE MONTHLY BULLETIN

Parsnip, badly infested by the root-knot nematode, *Heterodera radicola.* (Photo by Leroy Childs.)

OF

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STATE COMMISSION OF HORTICULTURE

December, 1913

THE MONTHLY BULLETIN

VOLUME II No. 12

DEVOTED TO THE DESCRIPTIONS, LIFE HABITS AND METHODS OF CONTROL OF INSECTS, FUNGOID DISEASES AND NOXIOUS WEEDS AND ANIMALS, ESPECIALLY IN THEIR RELATIONS TO AGRICULTURE AND HORTICULTURE.

EDITED BY THE ENTIRE FORCE OF THE COMMISSION UNDER THE FOLLOWING DIRECTORS:

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1913

ROOT-KNOT—CAUSE AND CONTROL, INCLUDING A LIST OF SUSCEPTIBLE HOST PLANTS.

By LEROY CHILDS, Assistant Secretary State Commission of Horticulture.

Very frequently roots of various plants, bearing knots and swellings, are sent in to the Commission with inquiries relative to the cause of the abnormality of the root system. More often than not this disarrangement may be ascribed to the presence of a minute, semi-transparent worm, *Heterodera radicicola,* which has established itself in the tender tissue of the root system. The presence of this minute parasite stimulates the plant tissues to such an extent as to cause an abnormal development, characterized by the familiar knotty, disorganized roots of a worm infested plant. (Figs. 390 and 397.)

This small, semi-transparent worm has adapted itself readily to many widely different varieties of plant life. At the present time over 480 species of plants are known to be susceptible to the attack of this parasite. A more thorough investigation would undoubtedly swell the host list considerably. Again, *Heterodera* is unknown in many localities, in which places the plant life of the region has never been subject to a test, or its susceptibility or insusceptibility learned.

Distribution.

The eelworm, as it is more often called, seems to be of world-wide distribution in the greater sense, being found in Europe, Asia, Africa, Australia and both North and South America. Though found rather universally all over the world, there are many localities in which the pest has never been known.

The original native habitat of this nematode has never been definitely established; arguments of various authors, however, seem to favor the tropics, from where, through the importation of various plants, both useful and ornamental, *Heterodera* has been transplanted unknowingly throughout the greater portion of the civilized world.

In the United States the distribution is decidedly spotted and it is at present regarded as a serious pest, and a menace to agriculture in only a few rather definite localities, especially in irrigated regions, the most prominent of which is an irrigated, potato-growing district in Nevada, where the depredations of the pest threatened the industry. The fact that the eelworm exists in so many places, doing little appreciable damage, is no criterion that all necessary care should not be exerted in checking any further distribution of the pest. *Heterodera* is a comparatively new-comer to our soils, and the maximum amount of injury which it is capable of inflicting has undoubtedly not been reached. Intensive farming and more thorough irrigation are two factors which, in creating a better environmental condition, are decidedly advantageous in increasing the number of worms which the soil may harbor.

The recent preliminary investigations in the citrus districts of the southern part of the State seem to show that an eelworm,[1] a close relative of *H. radicicola*, is responsible, in part at least, for the unproductivity and "decadence" of what were at one time first-class orange groves. Mr. E. E. Thomas,[2] of the University of California, in his preliminary report on the relation of nematodes to mottled leaf of the orange, brings to light many interesting facts which give promise of solving another one of the serious problems of the citrus industry.

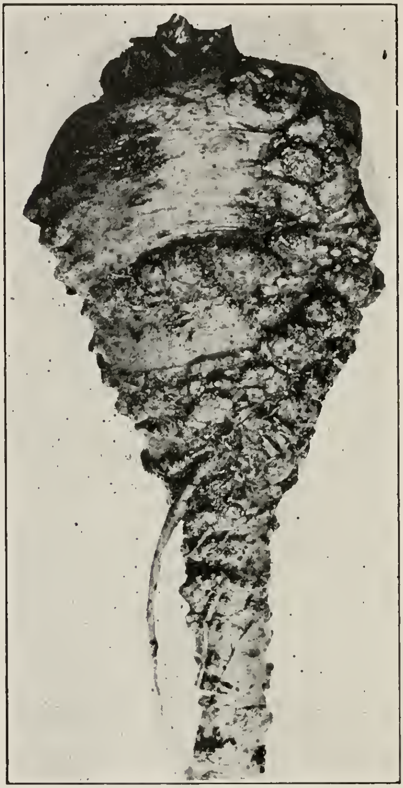

FIG. 390.—Parsnip badly infested by the root-knot nematode, *Heterodera radicicola*. (Original.)

Methods of Distribution.

Until comparatively recently the ordinary nurseryman and florist knew little of the cause of knots and swellings upon the roots of their stock, and during these years of ignorance the worm has been shipped throughout the temperate world. Owing to the widespread distribution of infested nursery and ornamental stock, the worm became universally established before any legislation was made against such shipments. The general wide dissemination of the eelworm being once established there are many channels present through which this nematode may infest a community. The eelworm moves freely in the soil during its larval or immature stages, possibly traveling a distance of six feet during its life. It is quite evident that its spread is not the result of its own volition, but trusts entirely upon its inconspicuousness, to be mechanically and unknowingly transplanted from one locality to another.

---

[1] Tylenchulus semipenetrans.

[2] Circular No. 85, University of California.

Accidental means, such as the severe washing of an infested area by rains furnishes a means of transportation, often for considerable distances. Wind has been suggested as a possible factor in dissemination, but owing to the fact that the worm is very susceptible to drought, it would be killed before the soil containing worms could be moved.

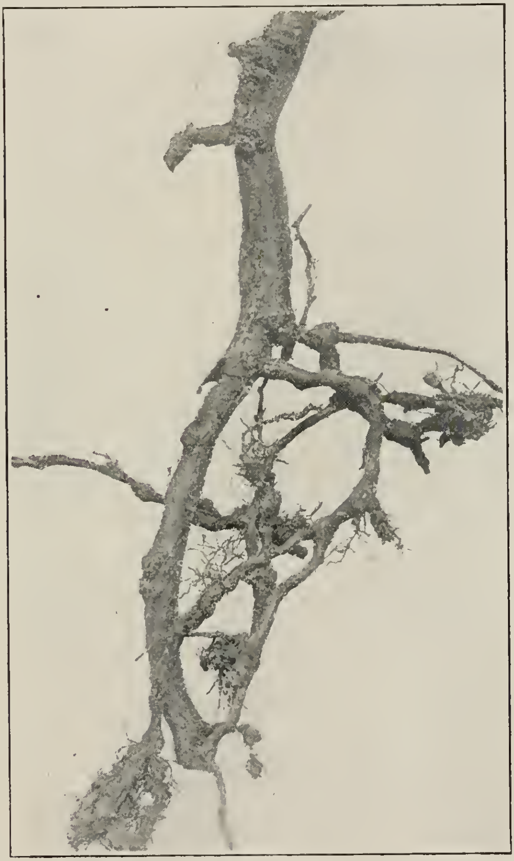

FIG. 391.—The work of the root-knot nematode on the small rootlets of peach. (Original.)

Mechanical transportation is undoubtedly more responsible for the distribution than the action of the elements, and this movement may be explained in numerous ways. Man himself unconsciously picks the worm up on his muddy boots, carries it from an infested area to an uninfested field. The same is true of the damp soil or mud containing worms being transported on wagon wheels, horses' hoofs and uncleaned cultivator teeth. How efficient is this method of distribution to the spreading of the pest in the citrus districts! Every grower has seen his cultivator come from the orchard with a bunch of root fibres clinging to the machine between the shank and shovel, and as there have been found as many as fifty worms on a rootlet an inch in length it is quite evident, owing to the method upon which many small ranches are operated, *i. e.*, by hired teamsters with their own tools, that many worms could be "sown" in a day.

Irrigation in areas where the pest has once been established offers an ideal method of distribution. The worm, though unable to live any great length of time in water, finds the damp, shady, irrigated orchard most advantageous for a successful existence.

Mr. Thomas found that the eelworm of the orange did not produce knots and swellings as had been previously reported, and for this reason, no doubt, the worm has been transported widely and unknowingly on infested nursery stock throughout the greater part of the citrus growing districts. Orange rootlets infested with the pest, though not possessing the characteristic swellings, do not appear healthy, as Fig. 396 will show. The cortex is irregular and rough, sometimes showing spots that appear like small bits of exuding gum.

Effect Upon the Host.

The direct effect of the worm upon the plant is at the point of contact, the result being the formation of knots, swelling and general disorder of the normal function of the root tissue. This displacement and disarrangement of tissues, results in a complete disorganization of the cellular makeup and arrangement, often to such an extent, that certain distinctive tissues with definite functions become entirely segregated from cells of the same kind.

In the case of the strawberry plant shown in Fig. 392 the rootlets show a distinct enlargement at the point of infestation; here, through the disorganization of cell tissues, a constriction is formed; food properties can no longer pass, and the rootlet beyond the swelling becomes functionless, and ultimately dies. When the roots of a plant become badly affected the direct influence upon the plant must be felt, and as a result that part above ground, by assuming an unhealthy appearance, will indicate the presence of some abnormal condition, the result of malnutrition through the loss of necessary plant foods taken from the plant by the small parasites in its root system and the reduction of food-getting facilities through disorganization.

Naturally, the condition of the plant varies directly in proportion to the number of parasites which it maintains, or to the resistant qualities which it may possess, so that the effect upon the many varieties of plants is not always the same. The symptoms are much more noticeable in fast-growing annuals than in trees and shrubs. Here the first indications of disease are the drooping and yellowing of the foliage. The plant in a short time becomes limp, the stems wilt and the hot rays of the sun soon burn up the weakened, poorly nourished tissues.

When vigorously growing plants suddenly turn yellow and die, immediately examine the roots, and the cause of the sudden death of the plant may usually be established by careful·observation. The telltale, knotty, disarranged root system will indicate the presence of the eelworm. Naturally, *Heterodera* can not be blamed for all sudden yellowing and wilting of garden plants, for the gopher or cutworm in feeding upon the roots will cause the same general effect; this work, too, may be easily identified by examination. Various bacterial diseases will also cause a wilting and yellowing in plant life and in the case of an attack of this kind the identity of the intruder is much harder to establish, and will demand services of an expert.

The effect upon trees is indeed variable in the many varieties that are subject to attack. In the case of young trees and nursery stock, the characteristic wilting and yellowing of the leaves is an indication of the presence of the nematode. In grown trees there is no set rule which can be applied and adequately mark the presence of this diseased condition of the root system. Invariably the following quotation accompanies nematode infested roots, which seems to hold true in most all kinds of orchard trees: "My trees are not doing well; the leaves are small and scattering, the limbs long and scraggly, and the fruit is small and often off season." Root specimens received, accompanied by this data, invariably show the presence of the eelworm.

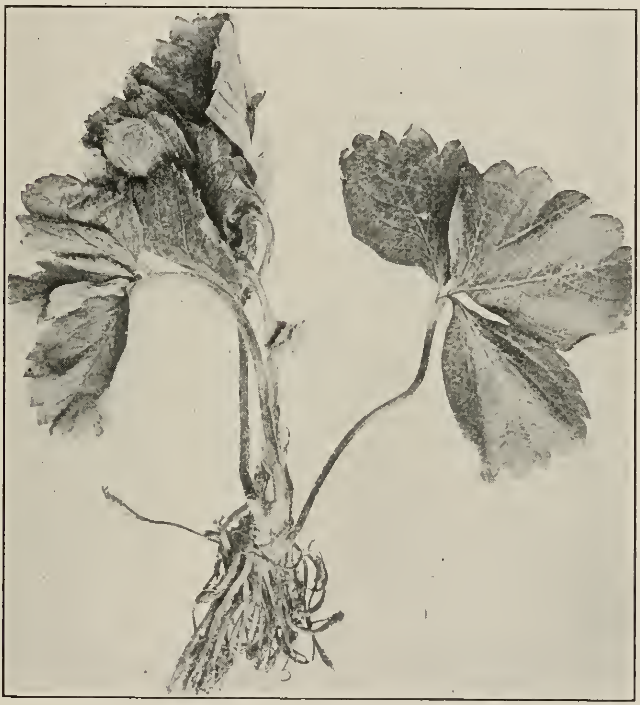

FIG. 392.—Strawberry plant, very susceptible to nematode attack. Note the terminal swellings on the rootlets; the root has been destroyed below the point of attack. (Original.)

Young peach and fig are often killed outright by this pest if planted in worm-infested soils. In the case of citrus trees there is much to be learned and the investigators who are at work will undoubtedly prove that the eelworm has a great deal to do with the poor condition of many orchards where thorough pruning, cultivation, irrigation, and fertilization have proven of no avail in restoring the productivity of numerous groves that are known to the writer.

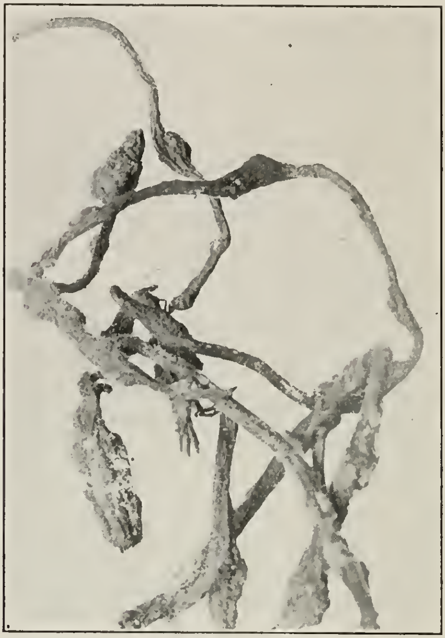

Fig. 393.—Fig rootlets containing the root-knot eelworm. Young figs are often killed by this pest when planted in a worm-infested area. (Original.)

Life History and Description of the Eelworm.

The eelworm is a very small organism, seldom exceeding one twenty-fifth of an inch in length, is semi-transparent and rather difficult to detect by the untrained eye. When examining a knot for this minute worm always endeavor to break the rootlet; do not cut, as very little pressure brought to bear upon this small creature ruptures the thin epidermal covering and its presence is overlooked. Close examination will usually reveal two types of the nematodes: a spindle-shaped form which is either the male worm or the larvæ (Fig. 394–4) (which can not be differentiated by the naked eye), and the adult female. The mature gravid female (Fig. 394–5) has lost her worm-like appearance and will appear as a pearly white, pear-shaped organism, firmly embedded in the plant tissue. This change takes place soon after the last moult in the larval growth. This transformation is the result of the development of the egg masses within the body.

The Egg.—The female is very prolific (Fig. 394–6), depositing no less than 400 or 500 eggs during her lifetime. These eggs are whitish, semi-transparent, bean-shaped bodies which are too small to be noticed without the aid of a lens or microscope. The time required in hatching the eggs depends largely upon weather conditions; in warm weather the small worms or larvæ may issue within two days after the eggs have been deposited, much longer being required in cooler weather conditions.

The Larvæ.—The larvæ upon hatching either establish themselves in the host plant in which they have emerged, or as is more often the case, leave the host and enter the soil. This is the only period during which the worms move to any great extent in the earth, where they either remain for some length of time or may immediately seek out a favorable root in which the various changes in development take place. The nematodes, in most cases, become completely buried in the plant tissues, establish themselves in the soft cellular structure of the rootlet which is rich in its food supply, and from which the worm readily draws its food. The head (Fig. 394–7) is provided with a boring apparatus consisting of a sharply pointed spear (Fig. 394–7*s*) which is located in the mouth: this arrangement not only aids in food getting, but is a valuable tool in battering through cell walls before it becomes definitely located.

The two sexes during development are indistinguishable up to fifteen or twenty days, both being spindle-shaped. In the mottling of the skin at this time there is a marked change in the case of the female, especially in the posterior region of the body, which no longer possesses a tail-like appendage. Fertilization undoubtedly takes place soon after this moult, for many radical changes in shape and structural organization of the worm take place, and the eggs begin to develop.

Adult Female.—The fertilized female (Fig. 394–5) increases rapidly in breadth, becoming a pearly white, flask- or pear-shaped individual. This is the type of organism one is most likely to see in breaking open a swelling or knot on a root-infested plant. This creature is far from being worm-like in appearance, and would be overlooked by one not versed in the life history of the eelworm.

Adult Male.—In shape the adult male worm is much like that of the larva (Fig. 394–4), being decidedly spindle-shaped in outline. The male does not inflict nearly as much damage to plant tissues as the female, and its purpose in life seems to be only that of fertilizing the female for, according to Bessey, after this function has been performed it is quite probable that the worm takes no more food. He reports finding numerous moving males with the alimentary canal reduced to such a condition as to be functionless, and the body cavity filled with disorganized granular masses, with the exception of the reproductive system, which is intact.

Control Measures.

The prime factor in the control of root-knot is the cost, and this is dependent upon the kind of culture to be treated, whether hothouse plants, intensively cultivated fields, or the ordinary products of general farming. Thus, for example, we could afford to place a considerable sum upon treating high-value plants segregated in a greenhouse, when we could not afford to similarly treat a general crop growing in the fields.

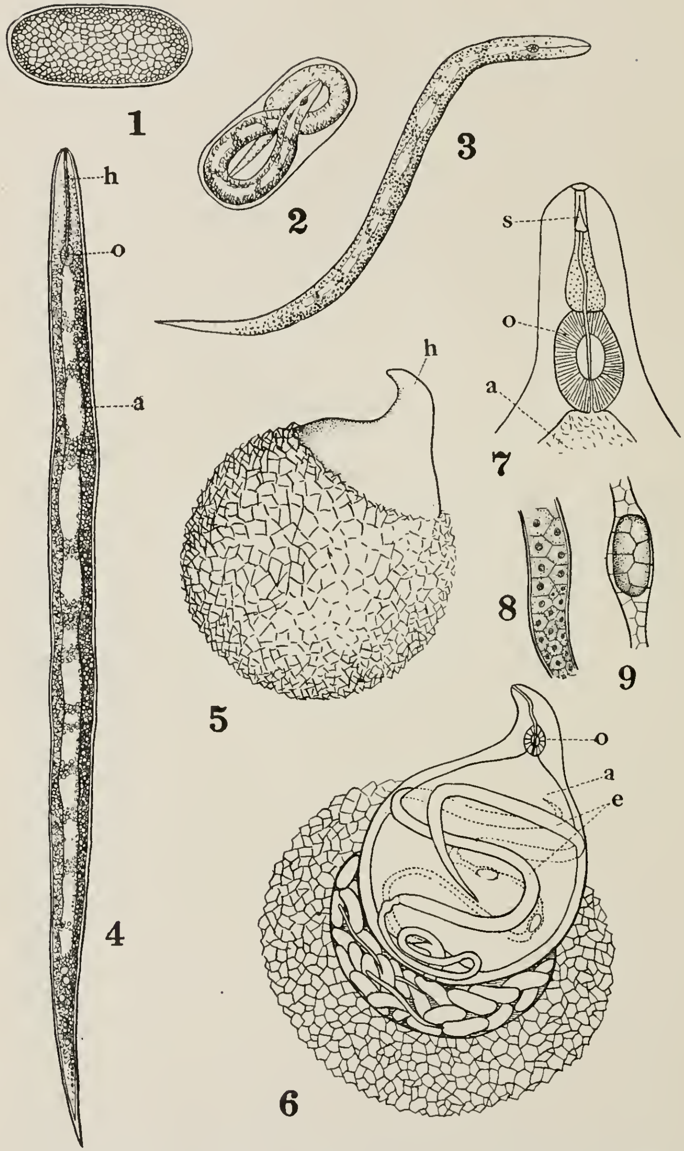

FIG. 394.—The common nematode or potato eelworm (*Heterodera radicicola* Greef). 1, egg, magnified 200 times; 2, showing developing larvæ within; 3, young larvæ magnified 200 times; 4, same, magnified 350 times; 5, adult female and gall magnified 70 times; 6, same, opened showing organs of female and eggs and young larvæ as they are found in the gall; 7, head of female, greatly enlarged; 8, part of egg tube, showing forming eggs; 9, another part of tube with a fully formed egg in it. *a*, alimentary canal; *e*, egg tube; *h*, head; *o*, œsophagus; *s*, spear. (Drawing by Newcomer.)

Control in the Greenhouse and Seedbed.

Steam.—The best known method of controlling root worms and root diseases in the greenhouse and seedbed is by the use of steam. The establishment of a steam plant in the greenhouse is a rather heavy initial expense, but when once established is permanent and may be operated at a nominal cost.

Pipes are laid at the bottom of the beds. These may be made of either iron or tiles, perforated at regular intervals of a few inches with holes about one sixteenth of an inch in diameter. The pipes, for good results in sterilization, should not be greater than two feet apart; a lesser distance would of course reduce the time actually needed to kill all of the worms. Before the steam is turned on the beds should be well covered by sacks, straw, old blankets, or the like, which will hold the heat in the top soil, allowing it to reach a temperature sufficient to kill any animal life.

The best plan in laying the pipes is to arrange them lengthwise in the beds, with the steam inlet located at one end in a cross-piece of pipe running across one end of the bed and into which all of the parallel pipes should open. For successful work it is very essential that no open ends be left in the pipe, as no pressure could be maintained.

The greater the steam pressure, the more successful the operation, since the work may be accomplished in much less time with the high pressure, which reduces the danger of saturating the soil to such a degree that it may become soggy. The reduction of the soil to this condition should always be avoided. Best results have been obtained with a pressure of 80 to 100 pounds to the square inch, and should never be allowed to fall below 40 pounds. High pressure has many advantages in that it is more efficient in its killing power, destroying all living matter with the possible exception of bacterial spores. In the case of soil bacteria, which are very essential to good soils, it is well that they are able to withstand this treatment. A simple and satisfactory method of determining the length of time steaming should be continued is obtained by placing potatoes under the covering on top of the soil in the bed being treated. These, placed in different parts of the bed will, when found to be cooked, indicate that the sterilization has been thoroughly accomplished.

Formaldehyde.—Of the various chemicals which may be applied in the greenhouse or seedbed, formaldehyde seems to be the most successful and economical agent. Successful treatment has been obtained in using the following formula:

Commercial (36 per cent to 40 per cent) formaldehyde	1 part
Water	100 parts
Application per square yard	1 to 1½ gallons

In case of very absorbent soils increase the amount to be used a little. After applying the formaldehyde, efficiency will be increased by thoroughly stirring the soil. Plants or seeds can not be planted immediately after application. The formaldehyde should be allowed to evaporate, this requiring a period of ten days before planting should be attempted. Stirring the soil during this time aids in ridding the soil of the chemical. Flooding may be used, but is not as satisfactory as the former method.

In very small seedbeds and benches the soil may be changed; care must, of course, be exercised in procuring soil that is free from the nematode. Before replacing, the frames should be thoroughly washed with a strong solution of formaldehyde or an application of hot, freshly slacked quicklime. This will destroy all larvæ and eggs that may be attached to soft decaying wood or that may be found remaining in the cracks. Old infested soil should be placed where it will do no harm. The worm may be killed by excessive drought. Do not throw on the ground, but place the removed soil upon boards or metal sheeting, spreading it out rather thinly and allow it to become thoroughly dried; by so doing the chances of establishing the pest in an uninfested area are greatly reduced.

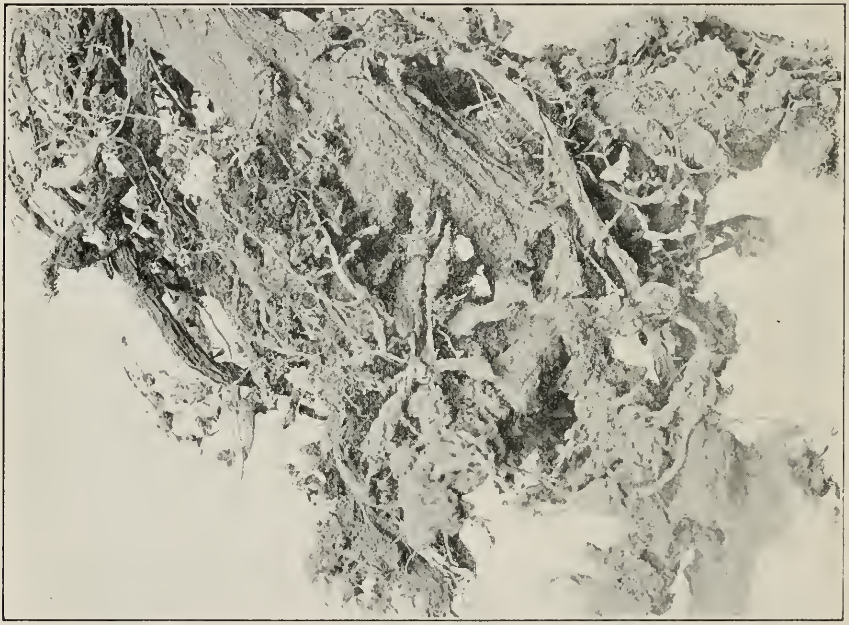

Fig. 395.—The badly disorganized root system of the tomato, the result of eelworm infestation. (Original.)

Field Control—Perennial Crops Present.

As has already been mentioned, control of the pest in the field depends largely upon the kind of crops that are grown. Tender growing rootlets and root hairs, which are the means through which the plant takes food from the soil, are extremely sensitive. Chemicals and control measures that are powerful enough to destroy soil pests are usually very harmful to the trees, especially if the plant is in a growing state. This factor must always be taken into consideration in experimentation with chemicals in the orchard.

Various chemicals have been experimented with in soil in which perennial plants are growing, these including carbon bisulphide, potassium sulphocarbonate, calcium carbide, and formaldehyde. The results obtained can be pronounced a complete success in no instance, carbon bisulphide seeming to possess the greater possibilities. In the cases of the other chemicals, owing to the indifferent success and the great expense occasioned in applying these, their consideration is out of the question for general use.

Carbon Bisulphide.—The use of this agent should never be attempted without first experimenting with one or two trees, to ascertain the effect, as the chemical is very powerful and is capable of inflicting serious injury. It should only be applied at a time when the trees are dormant, the roots being less susceptible at this time. The best method of procedure is to make holes in the ground to a depth of 10 to 15 inches; the liquid should be poured in and the holes immediately covered to prevent the escape of the gas, as the chemical is decidedly volatile. **It should be remembered at all times that the gas is both poisonous and explosive, and only the greatest of care should be exercised in handling.** Eight or nine holes to the square yard should be made and into each a teaspoonful of the liquid should be placed. Following these directions the amount used per square yard will total about 4 ounces, a dosage that has been found to be very satisfactory.

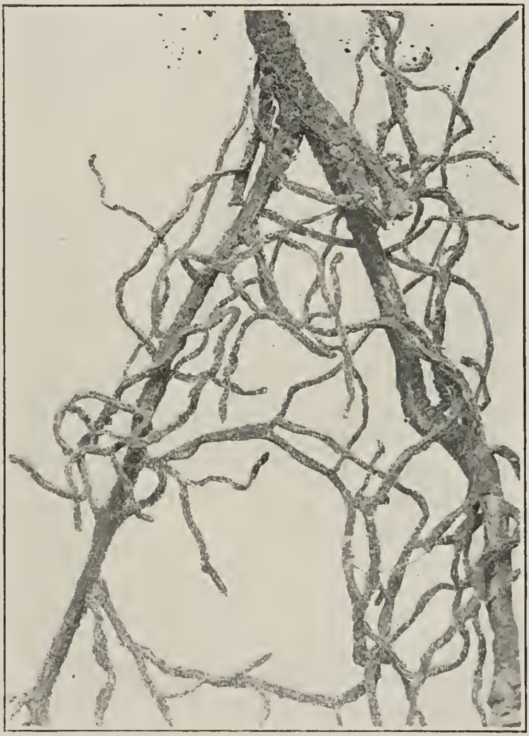

FIG. 396.—Fibrous roots of orange in which many nematodes were found living; note the absence of swellings. The orange eelworm, *Tylenchulus semipenetransis,* much resembles *H. radicicola.* (Original.)

Fertilizers.—Feltilization will undoubtedly prove, after more experimentation has been undertaken, to be one of the best methods of handling root knot by forcing the growth of the root system. Observations seem to show that the nematode confines its operations for the most part to the upper 12 to 16 inches of soil, so that if roots may be forced to grow deep enough they may escape injury. Knowing this fact, deep cultivation is an essential. The soil should be liberally supplied with nitrogenous fertilizers and potash. Potassium salts have been found to be beneficial, especially in potash-poor soils in which the nematode occurs. Changes in appearance of badly infested orchards to which potash has been applied have led many people to suppose that this fertilizer actually kills the worm. Resistance to the attack of the root-knot nematode through stimulation of the plant feeders is undoubtedly responsible for the reduction in numbers of the worms found to be present. It has been found in Germany that the sugar beet nematode removes equally all mineral salts from the roots. If, however, the soil is lacking in a particular mineral, the nematode in taking its equal proportion of all minerals will still further diminish the already depleted supply of that one. Therefore to benefit such a condition one would need to add only that mineral which was originally lacking. This may explain the effect of potash in combating this disease.

Field Control—No Crops Present.

Chemicals have been experimented with in the control of the root-knot in the fields where no crop is present and here again, owing to the great cost incurred in purchasing and applying, they can not be recommended. Of the various chemicals that have been experimented with, carbon bisulphide gave the best results. To successfully destroy the worm 4 ounces must be used per square yard and, as crude carbon bisulphide costs 10 to 15 cents a pound, the cost of the chemical per acre, without considering the necessary labor required, would range between $120 and $180. The cost of other chemicals experimented with have this same fault. However, in small areas, and in places where a tree is to be planted, carbon bisulphide may be used effectively; in doing so the tree is given an opportunity of obtaining a vigorous start and will establish its roots below the area occupied by the worm.

In 1906 Prof. Bessey carried on numerous experiments with various commercial fertilizers at Monetta, South Carolina. The results of this experimentation showed that fertilizers applied in sufficiently large quantities are valuable in producing crops in a nematode-infested region. The following extract from Prof. Bessey's ''Root-knot and its control''[3] will give an idea of the work that has been done with fertilizers:

> "* * * The following fertilizers were tested in 1906, mostly in one twentieth acre plats separated by ditches (or rather, very deep furrows) 2 feet wide, the numbers in parentheses referring to the field numbers of the plats: (12) Kainit, 1,000 pounds per acre; (13) ammonium sulphate, 667 pounds per acre; (14) kainit, 500 pounds per acre; (15) high-grade potassium sulphate, 1,000 pounds per acre; (16) check; (17) high grade potassium sulphate, 500 pounds per acre; (18) 17 per cent acid phosphate, 1,000 pounds per acre; (19) 17 per cent acid phosphate, 1 ton per acre; (20) check. In 1907 the following tests were

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[3] Root-knot and its Control, by Ernst A. Bessey, Bulletin No. 217, Bureau of Plant Industry, U. S. Dept. Agri.

made: (1) Kainit, 1,000 pounds per acre; (2) kainit, 1,500 pounds per acre; (3) high-grade potassium sulphate, 667 pounds per acre; (4) high-grade potassium sulphate, 1,333 pounds per acre; (5) ammonium sulphate, 1,000 pounds per acre; (6) muriate of potash, 1,000 pounds per acre; (7) potassium magnesium carbonate, 667 pounds per acre; (8) potassium magnesium carbonate, 1,333 pounds per acre. The checks received no numbers in 1907. The plats of that year and the checks were planted to tomatoes, okra, beans, and New Era cowpeas, all of which are very susceptible to root-knot. The last year's plats (1906 experiments) were also replanted in 1907 with these four plants. In 1906 the fertilizer plats were planted with New Era cowpeas and summer squashes. To all of the fields was applied each year, at the rate of 500 pounds per acre, a special brand of commercial fertilizer in common use in that vicinity, the soil being so poor that without some complete fertilizer nothing would grow well. The experiments were intended to show the effect, if any, of an excess of some particular fertilizer over the normal quantity applied.

The 1906 plats showed plainly the beneficial effects of potash fertilizers on the sandy soil of the experimental field. All the plats treated with kainit and potassium sulphate were darker green and the plants were far more vigorous than on the other plats. In fact, plats 12 and 15, respectively, kainit and potassium sulphate, both 1,000 pounds to the acre, were so far as the cowpeas were concerned, hard to excel anywhere. The squashes did not show much difference in any of the plats. They were badly infested with the squash bug, which killed the plants out in some of the plats. The cowpeas in plat 12 showed no nematodes and but few were present in the squashes. Plat 14 had a fair amount of root-knot in the cowpeas and from few to many on the different squash plants. The rest of the plats did not differ materially from the check plats which were fairly badly affected, in spots very badly.

The plants grown on these same plats in 1907 without the addition of the fertilizers again were badly affected except in plat 12, and somewhat in plat 15, which remained fairly free, showing a residual effect.

In the 1907 fertilizer experiments the following results were obtained. The kainit applications were injurious to the germination of the seeds, both the 1,000 as well as the 1,500 pound application, but naturally the latter more markedly. The amount of root-knot, however, in these plats was slight. Potassium sulphate at 667 pounds per acre was not injurious, but at twice that amount it so injured the germination of the cowpeas and beans that they required replanting. Root-knot was fairly abundant and strangely, more so in the more highly fertilized plat. In both plats the growth of the plants was very vigorous. The sulphate of ammonia at the rate used exerted a very harmful effect on germination, requiring several replantings. The plants that did grow, however, were very vigorous, dark green, and rather free from nematodes. The muriate of potash injured the germination of the beans and cowpeas, while the nematodes were fairly abundant. The potassium magnesium carbonate gave the best and most vigorous plants of all, without injury to germination. Root-knot was present in most of the plants, but not abundant.

Judging from these experiments, it is clear that fertilizers alone can not be depended upon to exterminate root-knot. On the other hand it is also plain that some fertilizers exert a beneficial effect upon the plant and enable it to make a good crop in spite of nematodes. Perhaps they may also increase the resisting power of the plant against the entrance of the nematodes into the roots. The potash fertilizers seem to be most favorable for this purpose, so far as the experiments at Monetta and observations elsewhere go. However, it will not be safe to conclude that they will be equally beneficial everywhere. In the sandy, rather potash-free soils of South Carolina and Florida the application of potash in amounts not too large seems to be followed by favorable results.

According to Stift,[4] Hollrung, in Germany, has shown that fertilizing highly with potash alone is not of much benefit to beets attacked by the sugar-beet nematode. Wimmer has shown that the nematodes remove the different minerals almost equally, so that only where one element is rather deficient will the addition of that alone be of benefit. The sugar-beet nematode removes large quantities of mineral food from the roots, so that unless these minerals are present in the soil in considerable excess over that naturally needed by the crop the plants will suffer from lack of that mineral which is not sufficiently abundant. Thus, an amount of potash sufficient for a healthy crop may be insufficient if the sugar-beet nematode is present, and the symptoms of potash hunger can be averted only by applying an excess of potash. Probably this is also true of the root-knot nematode. The sandy soils of South Carolina are rather potash poor, so that a diseased plant will suffer from potash hunger, while the other elements may be in sufficient abundance. At any rate, the addition of potash in excess proves helpful. The nitrogen-containing fertilizers when not in too great excess also benefited the plants somewhat, but not so markedly as the potash. This is to be expected, as nitrogen is not any too abundant in those soils. The phosphatic fertilizers, however, showed no benefit at all.

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[4] Stift, 1908.

> Caution must be taken not to apply too much potash. In 1907, in fact, kainit at 1,000 pounds per acre was harmful in that many of the young seedlings were killed, necessitating replanting several times, in order to get a fair stand. This quantity was not harmful in 1906 on another plat, showing that the danger limit is probably not far below that amount. Muriate of potash at the same rate was very harmful in 1907, as was also the same amount of ammonium sulphate. Potassium sulphate, 667 pounds to the acre, and potassium magnesium carbonate, 667 and 1,333 pounds to the acre, were absolutely harmless, while the latter amount of potassium sulphate was only slightly harmful.
>
> In spite of the high fertilization a field continually planted to nematode-susceptible crops will, if the nematode is present, eventually become so infested with that parasite that it will be impossible to make paying crops. However, it can not be denied that for special occasions it is of value to reduce part of the evil effects of the nematode infestation by high fertilization."

Starvation.—Probably the most effective method of ridding soil of *Heterodera* is attained by keeping the land free from vegetation for a period of two years. Where this is not practicable, nonsusceptible crops should be planted for two or three years. Care should always be taken in keeping out weeds that might serve as a host for this worm. By referring to the list of susceptible plants it will be noted that most of the ordinary farm crops can not be considered and those that are known to be resistant are few. The following list can be recommended: Cowpea (iron variety), all species of the Stizolobium (the velvet bean) and close relations, most varieties of winter oats (*Avena sativa*), peanut (*Arachis hypogæa*), Florida beggarweed, rye (*Secale cereale*), Crabgrass (*Syntherisma sanguina*), sorghum, milo, kaffir, timothy and red top. This list includes both summer and winter crops and in favorable localities the use of both is recommended.

For the most part these are crops that will barely pay expenses on valuable land, yet if the soil may be rid of the pest and expenses met it is well worth the necessary time and money losses incurred. Corn and sorghum have been especially recommended because they permit clear tillage and all weeds upon which the nematodes may live can be easily kept out.

Flooding.—Other methods, such as flooding, excessive drying and trap crops have been used with varying success. Flooding can not be applied with safety to fields bearing perennial crops, but under favorable conditions, where the soil may be kept under water and where all roots that might protect the worms have been removed, success has been attained by submerging the soil for a period of fifteen or twenty days. This method is impracticable in many instances, owing to the lack of sufficient water and unevenness of the infested area.

Drought.—*Heterodera* is particularly susceptible to drought and in regions of little rainfall, thorough drying of the soil has greatly reduced the injury from the pest. Ploughing deeply after the last rains in the spring will loosen the soil, and if kept unharrowed during the hot dry months of the summer, the numbers of worms will be greatly reduced. Of course, this method can only be applied in a region of very little or no summer rainfall, and in regions with no underground seepage.

Trap crops have been used but results that have been obtained do not warrant their use.

Summary of Control Measures That May Be Recommended.

In the Orchard.

At present no entirely satisfactory method of controlling or destroying root-knot is known.

Carbon Bisulphide.—Where it is the wish to reset young trees in a nematode-infested orchard carbon bisulphide applied to the soil at the rate of 4 ounces per square yard, placed in 8 or 9 holes to the square yard, gives satisfactory results. The holes should be at least a foot in depth and must be immediately filled after applying the liquid. Carbon bisulphide can not be used with safety around living trees.

Fertilization.—Heavy fertilization, together with thorough and deep cultivation, especially if the particular food properties which the soil is poor in be furnished, has been found to greatly improve the appearance and productivity of the orchard. The growth of the root system is stimulated and part, at least, is established below the range of nematode depredation.

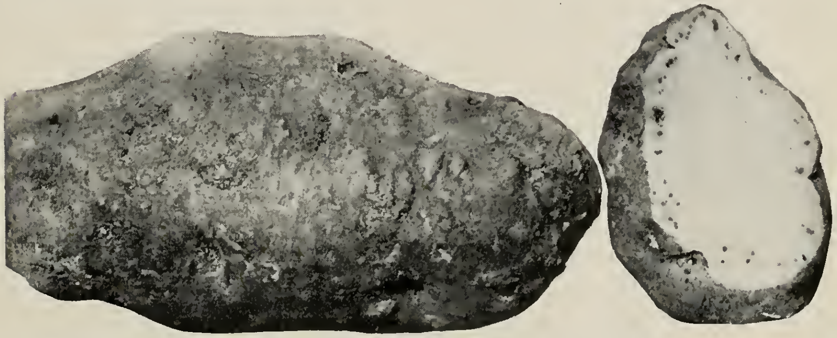

FIG. 397.—Potatoes showing injury inflicted by the eelworm. Tuber on left shows effect on skin; on right, tuber cut open shows colonies of the eelworms on the inside. (Photo by Bremner.)

Flooding.—Flooding can not be recommended in the orchard. Water allowed to stand on the ground long enough to kill the pest will greatly damage, if not destroy the trees.

Cover Crops.—Susceptible cover crops greatly increase the number of worms; in view of this fact avoid the planting of such crops. The iron variety of cowpea or rye can be recommended for the purpose.

In the Field—No Crops Present.

Starvation.—The most satisfactory method of ridding the soil of the pest is to keep it free from all vegetation for a period of two years. Allow no weeds to grow—this is a very essential point.

Nonsusceptible Crops.—The number of nonsusceptible plants is limited. For a winter crop, plant wheat, rye or barley; for summer crop peanuts, cowpeas (iron variety) or the velvet bean are recommended. Destruction of all weeds is also very essential to the success of this undertaking. The nematode infestation will be greatly reduced, often eradicated by continuing this process three seasons,

Flooding.—Flooding under favorable conditions has been used more or less successfully. To obtain good results the soil must be kept submerged for several weeks.

Excessive Dryness.—In regions of little rainfall, the number of nematodes can be greatly reduced by deeply ploughing the infested area after the last rains. The soil should be allowed to remain open during the hot weather during the entire summer. This method can not be employed where there is an underground seepage or summer rains.

Host Plants.

(The asterisk indicates plants in whose roots nematodes have been found, but incurring no serious injury.)

The following is Prof. Bessey's list, which includes all plants that are at the present time known to be susceptible to the attacks of *Heterodera radicicola:*

Abroma augusta L.
Abutilon sp.
Acacia dealbata Link.
Acacia, several species from Australia.
Achyranthes sp.
Ageratum conyzoides L.
Ageratum sp.
Ajuga reptans L.
Alfalfa—*Medicago sativa* L.
Alliaria officinalis Andrz.
*Amaranthus astropurpureus** Roxb.
*Amaranthus palmeri** S. Wats.
Amaranthus retroflexus L.
Amaranth, spiny — *Amaranthus spinosus** L.
Amaranthus tricolor L.
Almond — *Amygdalus* (Prunus) *communis* L.
*Ammi copticum** L.
Andropogon schoenanthus L.
Anemone apennina L.
*Anethum graveolens** L.
Angelica archangelica L.
Angelonia gardneri Hook.
Apricot—*Prunus armeniaca* L.
Apple—*Malus sylvestris* (*Pyrus malus*) Mill.
Argyreia nervosa (Burm.) Bojer.
Aristolochia clematitis L.
Artemisia absinthium L.
Artemisia caudata Mich.
Artichoke, Jerusalem—*Helianthus tuberosus* L.
Artillery plant — *Pilea serpyllifolia** (Poliv.) Wedd.
Asparagus—*Asparagus officinalis* L.
Aster sp.
Astrantia carniolica Wolf.
Astrantia major L.
Australian salt bush—*Atriplex semibaccata** R. Br.
Australian sarsaparilla — *Hardenbergia monophylla* (Vent.) Benth.
Avocado—*Persea gratissima* Gærtn.
Balsam apple—*Momordica charantia* L.
Balsam—*Impatiens balsamina* L. (*Balsamina hortensis.*)
Banana, Bruce's—*Musa ensete* Gmel.
Banana, Dacca—*Musa paradisiaca dacca* (Horan) Baker.
Banana — *Musa paradisiaca sapientum* (L.) Kuntze.
Banana, dwarf—*Musa cavendishii* Lamb. (M. chinensis.)
Balloon vine — *Cardiospermum halicacabum* L.
Barberry—*Berberis vulgaris* L.
Barley—*Hordeum sativum* Jess.
Basil—*Ocimum basilicum* L.
Bean, Aconite leaved—*Phaseolus aconitifolius* Jacq.
Bean, Adsoki — *Phaseolus angularis* (Willd.) Wight.
Bean, green gram—*Phaseolus radiatus* L.
Bean, horse—*Vicia faba* L.
Bean, Lima—*Phaseolus lunatus* L.
Bean, Metcalfe — *Phaseolus retusus* Moench.
Bean, green gram—*Phaseolus max* L.
Bean — *Phaseolus vulgaris* L. (Incl. *P. nanus.*)
Bean, Seeta—*Phaseolus calcaratus* Roxb.
Beech, *Carpinus betulus* L.
Beet—*Beta vulgaris* L.
Begonia coccinea Hooker (*B. rubra*).
Begonia metallica L. Smith.
Begonia olbia kuntze (Bolivia).
Begonia rex Putz.
Beggarweed, Florida — *Meibomia mollis* (Bahl.) Kuntze.
Bermuda (Devil) grass—*Capriola dactylon** (L.) Kuntze.
Bihai pulverulenta (Lindl.) Kuntze.
Birds-foot trefoil—*Lotus corniculatus* L.
Bird of Paradise flower—*Strelitzia nicolai* Reg.
Bittersweet—*Solanum dulcamara* L.
Blackberry — *Rubus subuniflorus* Rydb. (*R. villosus.*)
Bluegrass, annual—*Poa annua* L.
Bluegrass, Kentucky—*Poa pratensis* L.
*Boerhaavia decumbens** Dahl.
*Boerhaavia erecta** L.
Bonavist bean (Hyacinth bean)—*Dolichos lablab* L.
Bosea amherstiana (Moq.) Hook. f. (Rodetia).
Bouvardia sp.
Buckwheat—*Fagopyrum vulgare** Hill.
Buddleia sp.
Buffalo burr—*Solanum rostratum* Dun.
Burdock—*Arctium* sp.
Butternut—*Juglans cinerea* L.
Cabbage—*Brassica oleracea capitata.*

California privet — *Ligustrum ovalifolium** Hassk.
Candytuft—*Iberis umbellata* L.
Caraway—*Carum carvi* L.
*Carissa bispinosa** (L.) Desf.
Carnation—*Dianthus caryophyllus* L.
Carnation, pink—*Dianthus chinensis heddewigi* Regel.
Carnation, pink—*Dianthus plumarius* L.
Carob or St. John's bread—*Ceratonia siliqua* L.
Carpet weed—*Mollugo verticillata** L.
Carrot—*Daucus carota* L.
Cassava—*Manihot utilissima** Pohl.
Cassia mimosoides L.
Catalpa—*Catalpa speciosa* Warder.
Cauliflower, broccoli—*Brassica oleracea botrytis* L.
*Cecropia palmata** Willd.
Celery—*Apium graveolens* L.
Centratherum reticulatum (D. C.) Benth.
*Chenopodium boscianum** Moq.
*Chenopodium** sp.
Cherry, choke—*Prunus virginiana** L.
Cherry—*Prunus* sp. (from Mexico).
Chestnut — *Castanea sativa* (*C. vesca*) Miller.
Chick-pea—*Cicer arietinum* L.
Chicory—*Cichorium intybus* L.
Chinese cabbage — *Brassica pekinensis* (Lour.) Skells.
Chinese hemp—*Abutilon avicennæ* Gærfn.
Chinese mustard—*Brassica juncea** (L.) Cass.
Chocolate or cocoa—*Theobroma cacao* L.
Christ's-thorn — *Paliurus spina-Christi* Mill.
Chrysanthemum cinerariæfolium (Trev.) Vis.
Chrysanthemum—*Chrysanthemum* sp.
Chufa—*Cyperus esculentus** L.
Circaea intermedia Ehrh.
Clematis sp.
Clematis florida Thunb.
Clematis hybrida Hurt.
Clematis lanuginosa Lindl. & Paxt.
Clematis paniculata Thunb.
Clematis patens Morr. & Decais.
Clematis vitalba L.
Clematis viticella L.
Clover, bush—*Lespedeza bicolor** Turez.
Clover, crimson—*Trifolium incarnatum* L.
Clover, Egyptian — *Trifolium alexandrinum** L.
Clover, Japan — *Lespedeza striata* (Thunb.) Hook.
Clover, white—*Trifolium repens* L.
Coffee bean, wild senna—*Cassia tora* L.
Coffee—*Coffea arabica* L.
Coffee, Liberian—*Coffea liberica* Hiern.
Coffee, Robusta—*Coffea robusta* Hort.
Coleus—*Coleus blumei* Benth.
Coleus—*Coleus scutellarioides* (L.) Benth.
Coleus—*Coleus* sp.
Coral tree—*Erythrina americana* Mill.
Coriander—*Coriandrum sativum** L.
Cornflower—*Centaurea cyanus* L.
*Coronopus procumbens** Gilib.
Cosmos—*Cosmos bipinnatus** Cav.
Cotton, Sea Island—*Gossypium barbadense* L.
Cotton, Upland—*Gossypium hirsutum* L.
Cowpea—*Vigna unguiculata* (L.) Walp.
Crepis pulchra L.
Croton glandulosus simpsonii Ferg.
Crownbread—*Verbesina occidentalis* (L.) Walt.
Crownbread—*Verbesina virginica* L.* (*V. sinuata*).
Cucumber—*Cucumis sativus* L.
Cumin—*Cuminum cyminum* L.
Currant—*Ribes rubrum* L.
Cyamopis tetragonoloba (L.) Taub.
Cyclamen—*Cyclamen europæum* L.
Cyclamen—*Cyclamen persicum* Mill.
Cypress, spurge—*Euphorbia cyparissias* L.
Cypress vine—*Ipomoea quamoclit* L.
Daisy—*Bellis perennis* L.
Dahlia—*Dahlia pinnata* Cav.
Dandelion—*Taraxacum officinale* Weber.
Datisca cannabina L.
Dead nettle—*Lamium amplexicaule* L.
Desmodium sp.
Deutzia—*Deutzia crenata* S. & Z.
Devil grass (Bermuda)—*Capriola dactylon* (L.) Kuntze.
Dieffenbachia sp.
Dipsacus sylvestris Huds.
Dock—*Rumex* sp.
Dodartia orientalis L.
*Dolicholus intermedius** (P. & G.) Vail.
Dolichos biflorus L.
*Dolichos umbellatus** Thunb.
Downy lime-grass—*Elymus arenarius* L.
Dragon tree—*Dracæna rosea* Hort.
Eclipta alba (L) Hask.
Eggplant—*Solanum melongena* L.
Eleocharis palustris (L.) R. Br.
Elm, European—*Ulmus campestris* L.
Enchanter's nightshade—*Circæ lutetiana* L.
Endive—*Cichorium endiva* L.
Erythrina cristagalli L.
Eupatorium capillifolium (Lam.) Small. (*E. foeniculaceum.*)
*Euphorbia nutans** Lag.
*Euphorbia pilulifera** L.
Fenugreek—*Trigonella foenum—græcum* L.
Fig—*Ficus carica* L.
Fig marigold—*Mesembryanthemum* sp.
Fig, strangling (Wild rubber plant) *Ficus aurea* Nutt.
Ficus sp. (from Natal).
Ficus sp. (from Mexico).
Filbert—*Corylus avellana* L.
Flax—*Linum usitatissimum* L.
Frog-fruit—*Lippia nodiflora* (L.) Michx.
Fuchsia—*Fuchsia* sp.
Galinsoga parviflora Cav.
Geranium—*Pelargonium zonale* (L.) Ait.
German millet—*Chætochloa italica** (L.) Scrib.
Ginseng—*Panax quinquefolium* L.
Gladiolus—*Gladiolus* sp.
Gooseberry, Cape—*Physalis peruviana* L.
Gourd—*Lagenaria vulgaris* Ser.
Grabowskia glauca Hort.
Grape, Old World—*Vitis vinifera* L.
Grape—*Vitis æstivalis* Michx.
Grape—*Vitis labrusca* L.
Green gram—*Phaseolus radiatus* L.
Guava—*Psidium guajava* L.
Hawk's beard — *Crepis leontodontoides* Allioni.
Hawkbit—*Leontodon hastilis* L.
Heart-leaved basel—*Basella rubra* L.

Heliotrope—*Heliotropium* sp.
Heteropteris sp.
Hibiscus—*Hibiscus rosa—sinensis* L.
Hog plum—*Spondias lutea* L.
Hollyhock—*Althæa rosea* (L.) Cav.
Horehound—*Marrubium vulgare* L.
Horseradish — *Radicula armoracia* (L.) Robinson.
Hyacinth bean or Bona vista bean—*Dolichos lablab* L.
Hyssop—*Hyssopus* sp.
*Ilysanthes dubia** (L.) Barnh.
Immortelle — *Elichrysum bracteatum* (Vent.) Andr.
Impatiens kleinii Wright & Arn.
Indian potato—*Ipomœa* sp.
Ipomœa lacunosa L.
Ipomœa setosa Ker.
Iresine paniculata (L.) Kuntze.
Iris—*Iris* sp.
Ixora aurea Hort.
Ixora chinensis Lam.
Ixora crocea Hort.
Ixora fraseri Hort.
Ixora sp.
Jack bean—*Canavali ensiforme* (L.) DC.
Jacquemontia tamnifolia (L.) Griseb.
Jasmine, Cape—*Gardenia jasminoides* Ellis (*G. florida*).
Japanese honeysuckle—*Lonicera japonica** Thunb.
Japanese paper plant—*Tetrapanax papyrifer* (Hook.) Koch.
Jerusalem oak—*Chenopodium botrys* L.
Juncus gerardi Loisel.
Jute—*Corchorus olitorius* L.
Kadsura sp.
Kale, Collard—*Brassica oleracea viridis* L.
Lamb's-quarters — *Chenopodium album** L.
Latana—*Latana horrida* H. B. K.
Laurestine—*Viburnum tinus* L.
Leadwort, Cape — *Plumbago capensis* Thunb.
Leafy spurge—*Euphorbia peplis* L.
Leek—*Allium porrum** L.
Lentil—*Lens esculentia* Moench.
Lettuce—*Lactuca sativa* L.
*Leucæna glauca** (L.) Benth.
Linum angustifolium Huds.
Lobelia erinus L.
Lotus sp.
Love-lies-bleeding — *Amaranthus caudatus** L.
Lupine, white—*Lupinus albus* L.
Lupine, yellow—*Lupinus luteus* L.
*Lupinus angustifolius** L.
Lupinus termis Forsk.
Madeira vine—*Boussingaultia basselloides* H. B. K.
Maize or Indian corn—*Zea mays* L.
Mallow, wild—*Malva rotundifolia borealis** (Wallm.) Masters.
Manila hemp—*Musa textilis* Nee.
Mayweed—*Anthemis cotula* L.
Meadow fescue—*Festuca elatior* L.
*Meibomia stricta** (Pursh.) Kuntze.
*Melilotus indica** (L.) All.
Melothria crassifolia Small.
Mignonette—*Reseda odorata* L.
Milkweed—*Asclepias* sp.
Modiola caroliniana (L.) Don. (*M. multifida*).
Mollugo pentaphylla L. (*M. stricta*).
Moonflower—*Impomœa bona-nox* L.
Morning-glory, Fuchsia-flowered — *Ipomœa fuchsioides* Griseb.
Morning-glory—*Ipomœa purpurea* L.
Morning-glory, tree — *Ipomœa syringæfolia* Meissn.
Morning-glory, wild—*Ipomœa cathartica** Poir.
Mulberry—*Morus alba multicaulis* (Perr.) Loud.
Mulberry—*Morus alba tatarica* (L.) Loud.
Mulberry—*Morus nigra* L.
Mulberry—*Morus rubra* L.
Mulgedium macrophyllum (Willd.) DC.
Mullein—*Verbascum thapsus** L.
Musa rosacea Jacq.
Muskmelon—*Cucumis melo* L.
Mustard—*Brassica nigra** L.
Nasturtium, dwarf—*Tropæolum minus** L.
Nasturtium—*Tropæolum majus** L.
Nettle, horse—*Solanum carolinense** L.
Nightshade—*Solanum nigrum** L.
Nolano sp.
Oat grass, tall meadow—*Arrhenatherum elatius* L.
Oak, cork—*Quercus suber*.
Oats—*Avena sativa** L.
Okra — *Abelmoschus esculentus* (L.) Moench.
Oldenlandia sp.
Onion—*Allium cepa* L.
Orange, bitter—*Citrus aurantium* L. (*C. vulgaris*).
Orange, sweet—*Citrus aurantium sinensis* L.
Orchard grass—*Dactylis glomerata** L.
Oxalis stricta L.
Oxeye daisy—*Chrysanthemum leucanthemum* L.
Oyster plant, Spanish—*Scolymus hispanicus* L.
Papaya or melon pawpaw—*Carica papaya* L.
Paper mulberry — *Papyrius papyrifera* (L.) Kuntze.
Palm, California fan—*Washingtonia filifera microsperma* Beccari.
Palm—*Washingtonia gracilis* Parish.
Parsley—*Petroselinum sativum** Hoffm.
Parsnip—*Pastinaca sativa* L.
Passiflora pfordti (*P. alato-cærulea* Lindl.).
Passiflora sp.
Passion flower—*Passiflora incarnata* L.
Paternoster bean*—*Abrus precatorius* L.
Pea, field—*Pisum arvense** L.
Pea, garden—*Pisum sativum* L.
Pea, lesser chick—*Lathyrus cicera* L.
Pea, sweet—*Lathyrus odoratus* L.
Pea, Tangier—*Lathyrus tingitanus* L.
Peach—*Amygdalus persica* L.
Peanut—*Arachis hypogæa* L.
Pear—*Pyrus communis* L.
Pecan—*Hicoria pecan* (Marsh) Britt.
Pentagonia physalodes (L.) Hiern.
Peony—*Pæonia* sp.
Pepper, Betel—*Piper betle* L.
Pepper—*Piper nigrum* L.
Peppergrass, garden—*Lepidium sativum* L.
Perilla—*Perilla frutescens* (L.) Britt.
Persimmon—*Diospyros virginiana** L.
Persimmon, Japanese—*Diospyros kaki* L.

Petunia—*Petunia hybrida* Vilm.
Peruvian bark—*Cinchona* sp.
Physalis sp.
Pigeon tea—*Cajan indicum* Spreng.
Pineapple—*Ananas sativus* Schult.
Piriqueta tomentosa (Willd.) H. B. K.
Plane tree—*Platanus* sp.
*Plantago** sp.
Plantain—*Plantago major* L.
Pluchea purpurascens (Swartz) DC.
Plum—*Prunus domestica* L.
Podranea ricasoliana (Tanf.) Sprague.
Pokeweed—*Phytolacca americana* L.
Polygala oleifera Hort.
*Polygonum hydropiperoides** Mich.
Polygonum sp.
Pomegranate—*Punica granatum* L.
Poppy, California—*Eschscholtzia californica* Cham.
Poppy—*Papaver rhoeas* L.
Portulaca—*Portulaca grandiflora* Hook.
Potato—*Solanum tuberosum* L.
Primrose—*Primula carniolica* Jacq.
Princess' feather—*Amaranthus hybridus forma hypochondriacus** (L.) Rob.
Prunus cerasifera Ehrh (*P. myrobalanus*).
Prunus japonica Thunb (*P. nana* and *P. lanceolata*).
Pumpkin—*Cucurbita pepo* L.
Purslance—*Portulaca oleracea* L.
Quack-grass—*Agropyron* (*Treticum*) *repens* (L.) Beauv.
Quince—*Cydonia oblonga* Mill.
*Radicula walteri** (Ell.) Greene.
Radish—*Raphanus sativus* L.
Ragi millet—*Eleusine coracana** (L.) Gærtn.
Rain tree—*Pithecolobium saman* (Jacq.) Benth.
Rape—*Brassica napus* L.
Raspberry—*Rubus idæus* L.
Rattlebox—*Rhinanthus cristagalli* L.
Red pepper—*Capsicum annuum* L.
Rib-grass—*Plantago lanceolata* L.
Roquette—*Eruca sativa** Mill.
Rose, Cherokee—*Rosa lævigata* Michx.
Rose, Manetti—*Rosa chinensis manetti* Dippel.
Rose—*Rosa setigera* Michx.
Rose—*Rosa* sp.
Rose mallow—*Hibiscus coccineus* Walt.
Rose of Shannon—*Hibiscus syriacus* L.
Roselle—*Hibiscus sabdariffa* L.
Rubber plant—*Ficus elastica* Roxb.
Rubus trivialis Mich.
Rutabaga—*Brassica campestris** L.
Safflower—*Carthamus tinctorius** L.
Sage—*Salvia* sp.
Sainfoin—*Onobrychis viciæfolia* Scop.
Salsify, black—*Scorzonera hispanica* L.
Salsify—*Tragopogon porrifolius* L.
Scabiosa columbaria L.
Scarlet tassel flower — *Emilia sagittata* (Vahl.) DC.
Schizonotus sorbifolius (L.) Lindl.
Sedum (several species).
Sempervivum glaucum Ten.
*Sempervivum tectorum** L.
Senecio vulgaris L.
Sesban bispinosa (Jacq.) Steud.
Sesban macrocarpa Muhl.
Sesuvium maritimum (Walt.) B. S. P. (*S. pentandrum*).
*Sesuvium portulacastrum** L.
Seradella—*Ornithopus sativus** Brot.
Shallot—*Allium ascalonicum* L.
Sheep fescue—*Festuca ovina** L.
Sheep sorrel—*Oxalis corniculata** L.
Shepherd's purse—*Bursa bursa-pastoris* (L.) Brit.
Sida rhombifolia L.
Sida spinosa L.
Slender pigweed—*Amaranthus hybridus** L.
*Smilax glauca** Walt.
Snapdragon—*Antirrhinum majus* L.
Solanum sp.
Sorrel—*Rumex acetosa* L.
Soy bean (Soja bean) *Glycine hispida* (Moench.) Maxim.
Speedwell—*Veronica peregina** L.
Spermadictyon saureolens Roxb.
Spinach—*Spinacia oleracea* L.
Spiræa—*Spiræa cantoniensis* Lour.
Sponge gourd—*Luffa cylindrica* (L.) Roem.
Spurry—*Spergula arvensis** L.
Squash—*Cucurbita maxima* Duch.
Squash—*Cucurbita moschata* Duch.
Strawberry, American—*Fragaria chilansis* (L.) Duches.
Strawberry, European—*Fragaria vesca* L.
St. John's-wort—*Hypericum perforatum** L.
St. John's bread or Carob—*Ceratonia siliqua* L.
Stephanotis sp.
Stizolobium pachylobium P. & T.
Stitzolobium pruriens (L.) Medic.
Sugar cane—*Saccharum officinarum* L.
Sulla—*Hedysarum coronarium** L.
Sunflower—*Helianthus annuus** L.
Sunflower—*Helianthus debilis* Nutt.
Sunn hemp—*Crotalaria juncea** L.
Sweet alyssum—*Konig maritima** (L.) R. Br.
Sweet clover, white—*Melilotus alba* Desr.
Sweet fennel—*Foeniculum vulgare* Hill.
Sweet potato—*Ipomœa batatas* (L.) Poir.
Sweet William—*Dianthus barbatus** L.
*Syncarpia glomulifera** (Sm.) Niedenz.
Tamarind—*Tamarindus indica** L.
Tansy—*Tanacetum vulgare* L.
Tea—*Thea sinensis* L.
Teasel—*Dipsacus fullonum* L.
Theophrasta crassipes Lindl.
Thunbergi fragrans Roxb.
Thistle, common sow—*Sonchus oleraceus* L.
Thistle, sow—*Sonchus arvensis* L.
Toadflax—*Linaria canadensis** (L.) Dumont.
Tobacco—*Nicotiana tabacum* L.
Tomato—*Lycopersicum esculentum* Mill.
Trichosanthes cucumeroides (Ser.) Maxim.
Triumfetta rhomboidea Jacq.
Tuberose—*Polianthes tuberosa* L.
Tumbleweed—*Amaranthus græcizans* L. (*A. albus*).
Turnip—*Brassica rapa** L.
Ty-ess—*Lucuma rivicoa angustifolia** Miq.
Umbrella tree—*Melia azedarach** L.
Velvet bean—*Stitzolobium deeringianum* Bort.
*Veronica tournefortii** Gmelin.
Vetch, bitter—*Lathyrus sativus* L.
Vetch, hairy—*Vicia villosa* Roth.

Vetch, Narbonne—*Vicia narbonensis* L.
Vetch, scarlet—*Vicia fulgens** Battand.
Vetch—*Vicia sativa* L.
*Vicia astropurpurea** Desf.
Vicia hirsuta (L.) S. F. Gray.
Vicia monanthos (L.) Desf.
*Vicia pseudocracca** Bertol.
Vigna repens Baker.
Violet—*Viola odorata* L.
Vitis serianæfolia (Bunge) Maxim. (*Cissus aconitifolia*).
Walnut, Arizona—*Juglans rupestris* Engelm.
Walnut, English—*Juglans regia* L.
Watermelon—*Citrullus vulgaris* Schrad.
Wax gourd—*Benincasa cerifera* Savi.
Wayfaring tree—*Viburnum lantana* L.
Welch onion—*Allium festulosum* L.
Wheat—*Triticum æstivum* L. (*T. Sativum*).
Wild senna (coffee bean)—*Cassia tora* L.
Willow, weeping—*Salix babylonica* L.
Willughbæa scandens (L.) Kuntze *Mikania scandens*).
Wistaria—*Kraunhia sinesis** (Sims.) Greene.
Wire-grass—*Eleusine indica** L.
Wood sanicle—*Sanicula europæa* L.
Wormwood—*Chenopodium anthelminthicum** L.
Yam—*Dioscorea illustrata* Hort.
Ylang-ylang—*Cananga odorata* (Lam.) Hook & Thom.
Zamia floridana DC.

*PEAR CULTURE—HISTORY AND PRESENT STATUS.

By P. J. O'Gara, Pathologist, Medford, Oregon.

The pear is without doubt one of the most favorite fruits, although in its wild state its astringent qualities are so pronounced as to render it unpalatable. Under cultivation it has become an excellent fruit for all purposes, whether for dessert, for canning, for culinary use or in the fresh state. The cultivation of the pear extends to the remotest antiquity. It is mentioned in the oldest Greek writings and was cultivated by the Romans. It was common in Syria, Egypt and Greece, and from the latter country was introduced into Italy. The word "pear" or its equivalent occurs in all Celtic languages, while we also find it in Slavonic and other dialects; and from this it is inferred that cultivation of the pear, from the shores of the Caspian Sea to the Atlantic, was practiced in very ancient times. According to Virgil, Cato, Pliny and other Roman writers, the varieties in cultivation were very numerous, and from the names of important varieties usually referred to the countries from which the trees were imported. Unfortunately, none of the old Roman varieties exist to-day, but from the writings of Pliny we have every reason to believe that their best varieties of pears were very poor in comparison with the choice varieties under cultivation at the present time.

The pear of quality really dates from about the seventeenth century. However, it was not until Professor Van Mons of the University of Louvain, Belgium, by his perseverance and indefatigable labors succeeded in producing an immense number of new varieties of pears by selective breeding, that the growing of pears of commercial quality was put upon a sound basis. His whole life was mostly devoted to pear culture, and from among the 80,000 seedlings raised by himself we find the finest cultivated varieties of to-day—such as Bosc, Diel and others. The work of Van Mons has given the little country of Belgium the title of "The Eden of the Pear Tree." The net results of his work were given to the world a little more than one hundred years ago. Another worker, Thomas Andrew Knight, an Englishman, by hybridizing also produced varieties of noted quality. These two scientists and their followers, working from different points of view, produced fruits that have, by further cultivation, reached the limit of perfection.

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*This splendid paper first appeared in "Better Fruits," October, 1913, and its contents applied so well to California conditions of pear growing that we obtained permission from Mr. P. J. O'Gara to use it in The Monthly Bulletin, which he kindly gave as well as the use of the cuts for illustrative purposes.—Editor.

From the standpoint of the botanist, there are some differences in opinion as to the species from which cultivated pears are descendants. There are some who hold that cultivated pears have descended from at least three species, while others who have very carefully studied the subject refer all cultivated pears to one species, the individuals of which have in course of time diverged in various directions so as to form now six races: (1) Celtic, (2) Germanic, (3) Hellenic, (4) Pontic, (5) Indian, (6) Mongolic. From the Germanic race we have what is commonly known as the European pear, *Pyrus communis*, while from the Mongolic race we have the Oriental pear, *Pyrus chinensis*. Of course, it is understood that there are many wild varieties which come under the various groups. From the horticulturist's point of view there is a totally different classification, namely, dwarf, standard and Oriental. The dwarf pear consists mainly of European varieties propagated by grafting onto rooted cuttings of the Angiers quince. The Japan Golden Russet is also used for dwarfing, but it is to be generally understood that the dwarf pear means the pear worked on the quince root. Standards consist of the European varieties propagated on the pear root, the stocks for this purpose being European or Japan pear seedlings or rooted cuttings of some of the Oriental pears. The Orientals are those which are partly or wholly of Chinese or Japanese origin. So far as the pure Oriental pear is concerned, there are very few plantings. The important commercial varieties of this group are really hybrids between the Oriental and the European pears and consist of such varieties as Kieffer, La Conte, Garber, Smith and others of minor importance. The reason for this separation into three groups is because the requirements of the varieties coming under each group are usually quite different, demanding distinctive cultural methods. With few exceptions, dwarfs must be considered as belonging to the small gardener or the amateur horticulturist; the Oriental hybrids, so far as the quality of their fruit is concerned, have no place in the commercial pear orchards of the Pacific coast. Therefore, in considering commercial pear growing in the better sections of the extreme West, we must have in mind the better varieties which have sprung from the European type or group grown as standard trees.

In looking over the more or less voluminous literature on pear culture, we find it frequently states that pear trees are more difficult to maintain in a healthy, productive condition than apple trees, and can not be grown with the same degree of success over so wide an area of country. This statement is only partly true, for while the pear does not enjoy the same degree of success over so wide an area of country as does the apple, nevertheless with proper soil and climatic conditions the pear will much outlive the apple. There are natural pear sections or districts, just as there are apple districts, and given the suitable varieties for such districts, the pear will always outlive the apple. At the same time the pear will have produced commercial fruit for a longer period and the net returns will be much greater. In its wild state it is hardier and longer lived than the apple, making a taller and more pyramidal head and becoming much larger in trunk diame-

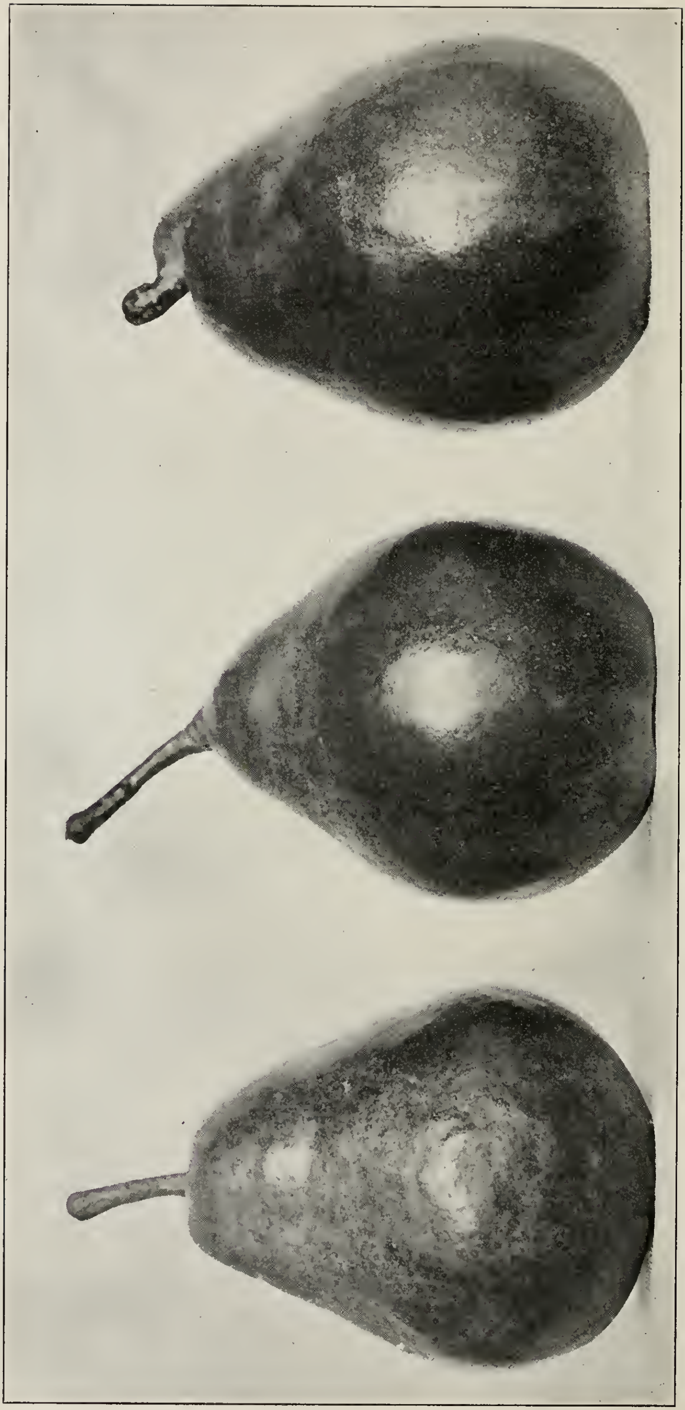

Fig. 398.—Leading varieties of pears grown in Rogue River Valley, arranged in order of their ripening period—Bartlett, Howell, Anjou. (Original.)

ter. While apples are known to reach the great age of 200 years, many pear trees are known to be 500 years old. On the Pacific coast we find pear trees still in bearing in the old Mission orchards of California. These pear trees, after nearly two and a quarter centuries, are still holding their own, with a few olives and date palms as companions standing as reminders of the old civilization.

In a short article such as this is it is quite impossible to discuss the important subject of varieties at any length. Considering the Pacific coast, we find a wide variety of soil types (even in restricted areas), climatic conditions, elevations, etc. The varieties best adapted under the various conditions is a subject for wide discussion. In a few localities, principally throughout California and the Rogue River Valley in southern Oregon, the matter of varieties best suited to the varying conditions has been well worked out, so that at this time growers are not making the mistakes so common in the past. Besides the matter of soils, climatic conditions, etc., the important matter of the market demands for the various varieties must be well understood. Taking the Rogue River Valley as an example, all plantings now made, or which have been made during the past five or six years, take into consideration all the above factors. In going over my notes I find that over fifty varieties of pears may be found growing in the Rogue River Valley, yet out of this number seven varieties are really commercial. The varieties in the order of their ripening are Bartlett, Clairgeau, Howell, Anjou, Bosc, Comice, Nelis. Besides these seven varieties, we

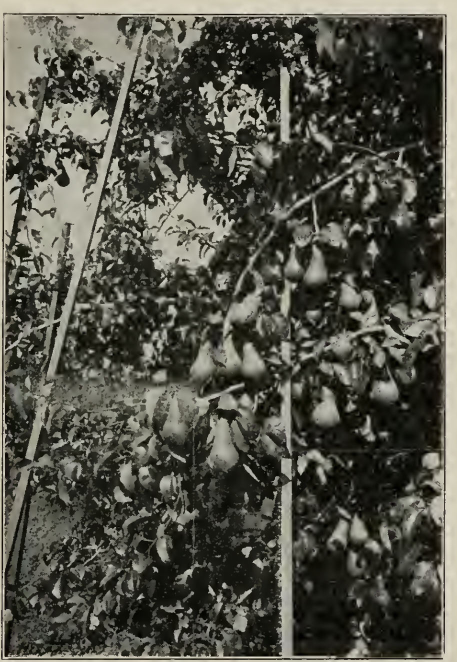

FIG. 399.—Bearing branches of Bosc pears. Hollywood orchard, Medford, Oregon. (Original.)

have planted considerable acreage of P. Barry and Forelle; however, these latter varieties are not yet in bearing commercially. I do not mean to say that the other varieties grown in the valley are not good; as a matter of fact they are excellent, nevertheless the market demand does not warrant the multiplication of varieties. In the seven commercial varieties mentioned it would be just as well to omit the Clairgeau, which in no way compares with the excellence of the other varieties. The great pear districts of the Pacific coast, so far as the future of the pear industry is concerned, will be southern Oregon (Rogue River Valley) and California, principally the great Sacramento Valley and its tributary districts. In this natural pear belt any one or all of the commercial varieties of pears may be grown; that is to say, hundreds of varieties. But pear growers must not fall into the error of planting too many varieties, as has been the case in commercial apple growing throughout the entire Northwest. Not long ago a horticulturist, waxing enthusiastic over the excellent quality of the pear as grown in this district (Rogue River Valley), said that the pear growers were making a mistake in not growing at least 100 varieties. Viewing the pear situation from the apple standpoint, especially considering market conditions, it would be financial suicide for any district to grow commercially more than six or eight varieties. If there is any doubt in the matter of too many varieties it would be well for the reader to secure a copy of a paper written by Mr. W. F. Gwin, manager Northwest Fruit Exchange, Portland, Oregon, entitled “What

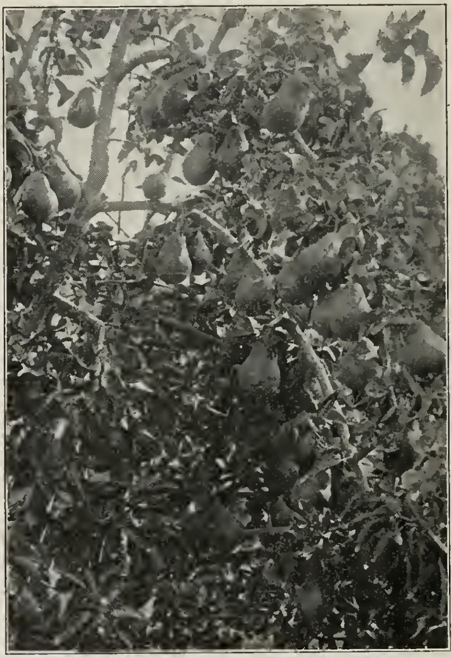

Fig. 400.—Bearing branches of Bartlett pears. Gore orchard, Medford, Oregon. (Original.)

is the Matter With the Apple Business?" In this most excellent paper Mr. Gwin shows clearly the danger of too many varieties.

It sometimes happens that new or better varieties are needed, but they should be added with the ultimate intention of having them take the place of inferior varieties already growing and not to increase the total number of varieties. This holds true with the individual as well as with the district as a whole. Where orchards are large the number of varieties grown may be the maximum number suited to the district, providing the soils are suitable; however, with the small grower it is best to restrict the plantings to two or three varieties. As a business proposition, it is never advisable to plant less of any one variety than will produce carload shipments, unless it be for pollination purposes.

In setting out a pear orchard less regard may be had for the character of the soil than for almost any other kind of fruit. It will generally do well over a tight clay hardpan where almost any other fruit would fail. It will also thrive in clay loams and adobes as well as in calcareous and alkali soils. The pear will flourish whether the water is near or far from the surface, and can endure complete submergence in water for a considerable length of time without being killed. During periods of high water in the lower Sacramento River districts I have seen pear orchards completely under water, which did not fully subside for several months. The regular orchard work, such as spraying, pruning and thinning, was carried on by the use of boats and barges. However, the pear demands a good soil for its best development, and naturally the heavier alluvial, clay loam and other types rich in plant food are the best. The variety which is least exacting is the Bartlett. Anjou, Clairgeau, Howell, Nelis and Bosc thrive on heavy soils, including the heavy adobes. For early bearing such varieties as the Bosc and Comice are best grown upon the clay loam soils. The Comice comes into bearing rather slowly if grown on too heavy soil. While the Nelis produces the best quality of fruit on the lighter clay loam soils it does not attain as good size as the market demands. However, increased size of the fruit might be secured by irrigating during seasons of minimum rainfall.

The distance for the planting standard pear trees will depend somewhat upon the varieties. Due regard must be had for such varieties as the Bosc or Anjou, which have a tendency to grow in a spreading form, as against the Comice and Bartlett, which are naturally upright growers. The maximum distance for spreading varieties should not be over 30 feet, either square or hexagonal system. The minimum distance should not be less than 22 feet, square or hexagonal. The average distance practiced in the Rogue River Valley is 25 feet, both systems. However, the common practice is not to plant solid blocks of any one variety, for the reason that certain varieties are self-sterile and require the pollen of other varieties to fertilize the blossoms.

Self-sterility and self-fertility are not constant quantities in the same variety; that is to say, the variety may be self-sterile in one district and self-fertile in another. One can not tell beforehand just what a variety will do when taken from one district into another where climatic conditions and soils are very different. On the Pacific coast there is a greater tendency to self-fertility than in the East, although varieties in the self-sterile group under Eastern conditions and quite

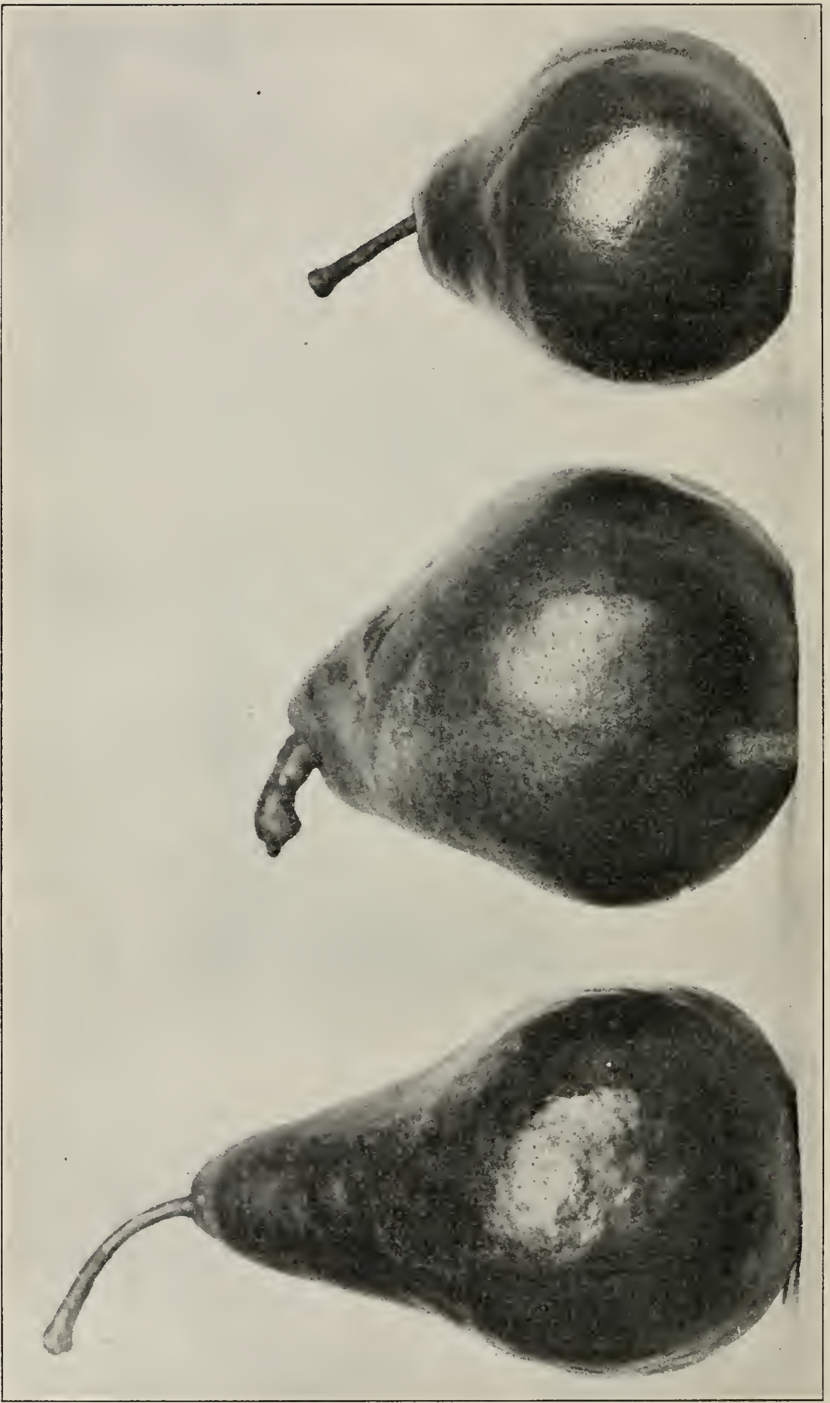

Fig. 401.—Leading varieties of pears grown in Rogue River Valley, arranged in the order of their ripening period—Bosc, Comice, Winter Nelis. (Original.)

self-fertile on the coast, have the quality and form of the fruit improved by crossing. Generally speaking, on the Pacific coast little or no attention is paid to the Bartlett so far as fertility or sterility is concerned. It regularly sets heavy crops of well-sized fruits with its own pollen. On the other hand, such varieties as Comice and Nelis are completely sterile to their own pollen in the Rogue River Valley, all statements to the contrary notwithstanding. As stated before, the matter of self-sterility and self-fertility should be worked out for the various varieties in each particular district. I have worked this problem out for the Rogue River Valley, and since the data have been published elsewhere I shall not burden the reader with it here.

While volumes might be written on how to prune the pear, the whole principle of pruning may be stated in a single short sentence—use the open head, no matter what variety. In such varieties as tend to grow very upright, they should be pruned so as to throw them more open, while the reverse should be practiced to a certain extent on straggling or spreading varieties. The tree when set out should be headed back so as to stand 18 to 24 inches high. After the first year's growth, the frame limbs should be selected and headed back to 12 or 14 inches. During the growing season, if the trees are making extreme growth and producing too many shoots it is well to pinch back or trim out those that are in excess of the needs of the tree. If the season has been such that the trees have made little or no growth, the shoots should be headed back to a single bud so as to start a new frame of vigorous shoots. The successive years' pruning should be such as to continue the open head, and by shortening in to not over eighteen inches for each cut, stiffen up the body and framework. The frame or scaffold branches need not be pruned of all the lateral shoots. Those to the inside and some on the outside should be removed, but a few may be left as temporary fruiting branches which, by heading in, will readily develop fruit spurs. Fruit borne on these temporary fruiting branches will hang close to the tree and will not have a tendency to throw the tree out of shape, which so often happens where the first crop is borne somewhat above the scaffold limbs. By means of the temporary fruiting branches trees are brought into early bearing, and at the same time no fruit spurs need be permitted on the body or scaffold limbs. The reason for keeping fruit spurs off from the heavy wood is to prevent dangerous body infections of pear blight. Should infection occur on a temporary fruiting branch it is easily removed before any damage is done to the body of the tree. Pears reach the bearing age, under proper care, earlier than do apples, and once in bearing pruning will not have the tendency to throw them out of bearing as it will in apples. However, severe heading of such varieties as Bosc and Comice is not advised; as a matter of fact after they reach the age of five or six years it is best to withhold all pruning for two or three years, saving the thinning out of crossing or interfering limbs.

The details of cultivation, fertilization and cover cropping need no extended discussion. To grow fruit of quality demands all that good agricultural practice has taught in the production of other crops; in other words, the pear demands scientific agriculture. Unthrifty trees can not produce luscious fruit; however, it is not good practice to over-stimulate the trees for the reason that they are then much more susceptible to serious injury from pear blight should infection occur. It will be easy for the pear grower to judge whether or not his trees are making sufficient new wood. It will also be easy for him to note by the appearance of the foliage the lack of soil fertility.

Pear growing in the United States is generally on the decrease, the reason for this being pear blight. Many districts that were once known for their heavy pear shipments are now without a single pear tree. In the East we find that southward from the region of the Great Lakes the growing of the better varieties of European pears has been largely abandoned, and to a certain extent we find growing in their stead the two or three Oriental hybrids, spoken of elsewhere in this paper. Of course, large quantities of pears are produced in the East, but for the most part they do not compare in quality with the standard varieties grown on the Pacific coast. This fact is evident from the great difference in price between the Eastern and Western product. While the East and Middle West have suffered much from the ravages of pear blight, many large districts in the West have also had their share of trouble. In some states entire districts have been wiped out, and it is known that in one state only a single pear orchard of about 500 trees remains. The only district on the Pacific coast which has not only held its own but has actually increased its pear acreage and production is the Rogue River Valley in southern Oregon. The rate of increase may be shown by the carload shipments made in 1911, 1912 and 1913, which were respectively 125, 250 and 500 cars (1913 crop

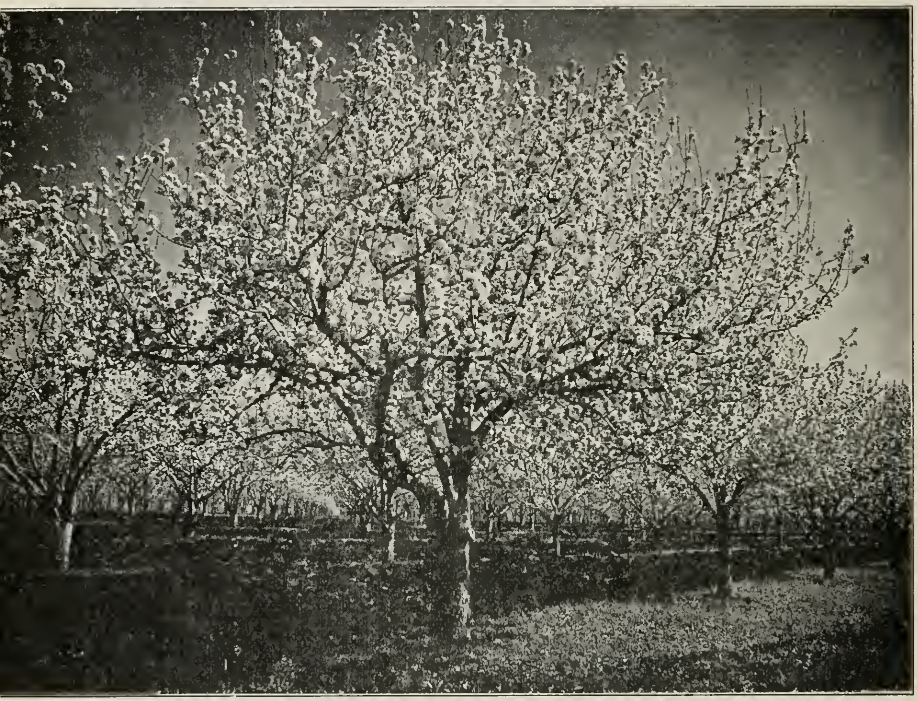

FIG. 402.—Anjou pear tree in full bloom. Holloway orchard, Medford, Oregon. (Original.)

estimated). Pear blight has been known to be in the district since 1907, so that the growers have had to contend with it for seven seasons. It would seem that some very good work has been done in the control of this disease, as the increased shipments demonstrate. When pear blight came into the Rogue River Valley from the California districts the growers, finding it impossible to get any help from their own state institutions, appealed to the federal government for aid, which was immediately forthcoming. After the United States Department of Agriculture had demonstrated the control of blight the growers, feeling the necessity of continued supervision, established a county pathologist's office, the first of its kind in the United States. This office continues the work first undertaken and carried to success by the Department of Agriculture. The fact that pear growing is on the increase in the Rogue River Valley is due to the efforts of the growers themselves. When they found that there was no possibility of getting help within their own state they immediately set out to help themselves.

It has been stated frequently that pear blight is a disease of pome fruits on the American continent; however, it is now known that the disease has secured a foothold in Europe. It has been reported from at least three countries in Europe, and while it has not yet shown great virulence we are anxiously awaiting what will likely happen when the disease reaches the fine pear districts of Holland, Belgium and France. Now that the disease is in Europe, and will likely spread to the better pear sections, we should more than ever feel the necessity of guarding our pear interests in the better pear-growing sections of the United States; for pear blight anywhere usually means reduced acreage and reduced crops—therefore higher prices. Undoubtedly the countries of Europe will make every effort to prevent the spread of this disease, but the disease being new to them, and not being fully understood by them so far as control is concerned, will mean that there must be some loss once the disease enters a district.

Does pear growing pay? Does it pay to control pear blight? Aside from pear blight, the pear tree is troubled less by insect and fungous pests than is its near relative, the apple. Furthermore, blight is no more severe in the more susceptible varieties of pears than it is in many varieties of apples, notably Spitzenberg, Alexander, Transcendent Crab and many others. The question as to whether it pays to control blight may be easily answered by giving the average prices over a six-year period for pears shipped from the Rogue River Valley. The prices given are those obtained through the association as well as by individual growers, and represents f. o. b. averages for the first and second grades. The average prices received during the years 1907 to 1912, inclusive, are as follows: Bartlett, $1.35; Winter Nelis, $1.65; Howell, $1.95; Bosc, $2.30; Comice, $2.45; Anjou, $2.50.

All apple growers throughout the Northwest know what it costs to raise a box of apples, and, taking everything into consideration, we have found that it costs somewhat less to raise a box of pears.

The future of pear growing in any district will depend upon the ability of the growers to control pear blight. If they are unwilling to co-operate and carry out the work of eradicating the disease, which is the only method of control, it will be just as well for them to pull out their pear trees and have the agony over. For the district which will control pear blight the disease may be considered a blessing in disguise. Owing to the fact that the pear is very prolific and is otherwise very free from troubles, if there were no such disease as pear blight pears could be produced in such enormous quantities that there would be no profit in growing them. But blight will continue to keep the production limited, and there will always be a handsome profit in pears.

A CASE OF ARSENICAL INJURY TO APRICOT TREES.

By Geo. P. Weldon, Chief Deputy State Commissioner of Horticulture.

It has been known for some time that arsenic applied to trees in the form of lead arsenate, Paris green, etc., for the control of insect pests, may accumulate at the crowns and a sufficient amount become soluble to corrode the bark and girdle the trees. Dr. W. P. Headden of the Colorado Experiment Station and Prof. D. B. Swingle of the Montana Experiment Station have given in publications from their respective stations much analytical and experimental proof of such injury.

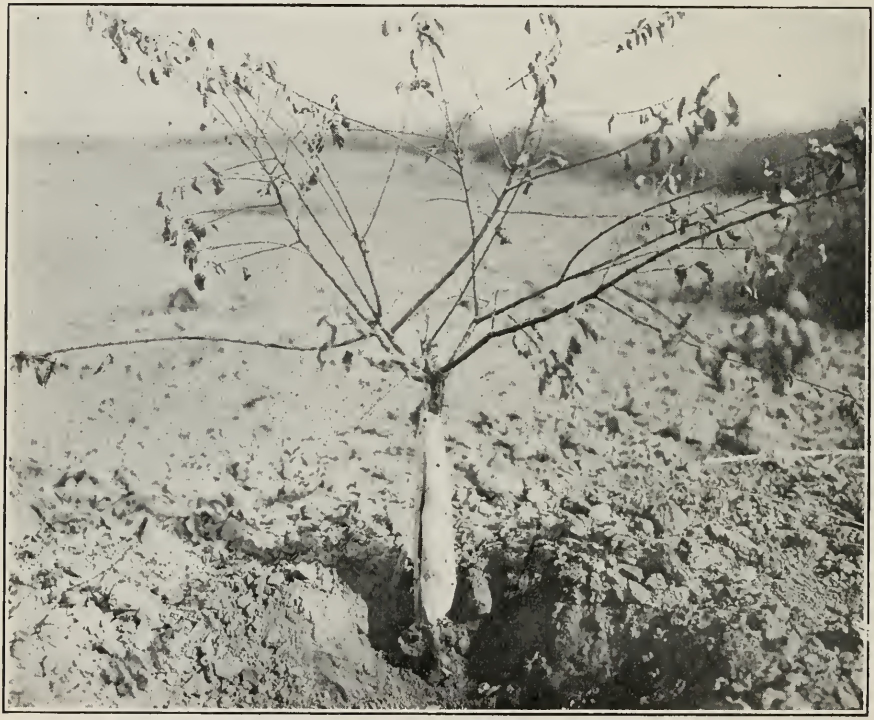

Fig. 403.—Dead roots near the crown of young apricot tree, due to arsenical injury. (Original.)

Typical cases of this damage to orchard trees may be recognized in advanced cases by the following symptoms: foliage small and yellow, or at least unnaturally colored early in the season. Usually there is a very heavy crop of fruit, also highly colored. Longitudinal cracks often occur in the bark which may be discolored an unnatural yellow.

Corrosion at the crown completely girdling the tree in extreme cases and in others involving only part of the crown. Dead roots or at least portions of some of the larger roots near the crown are common symptoms. In all typical cases the injury to the bark begins on the outer surface and gradually the arsenic eats its way through to the cambium. The wood of limbs, trunks and roots of injured trees is more or less blackened. In most cases where injury is at all severe girdling and death of the tree takes place.

An interesting case of similar injury to some young apricot trees was seen in Kings County recently. Early in the season climbing cutworms gave considerable trouble by destroying the buds and in an effort to rid the orchard of this pest the owner prepared a bran and Paris green mash which he placed in generous piles about the crowns of the affected trees. After a time the orchard was irrigated and very soon the trees began to look sickly, many dying outright. When the orchard was visited on October 28th some of the trees were still alive but showed the characteristic symptoms of arsenical injury. An examination of several of the crowns was made and the bark was found to be more or less discolored and corroded in each case. In places it was very black and could be crumbled easily between the fingers. Above the ground line the bark was green and the top of the trees showed a sickly, yellow color and an unthrifty growth to indicate the crown and root condition. One of these trees is shown in Fig. 403. The portion of the trunk from the crown down, and some of the roots were dead. Uninjured trees in the orchard were still in good foliage and the picture gives an idea of the appearance of those that were injured. Fig. 404 shows the portion of the orchard where the injury was done and gives some idea of the extent.

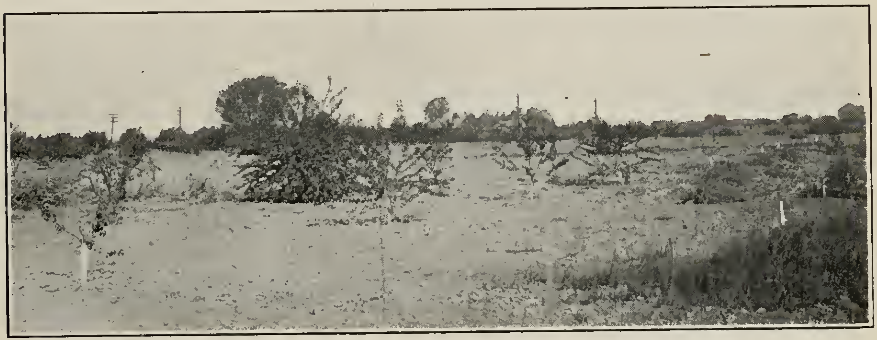

FIG. 404.—Young apricot orchard injured by arsenical poisoning; note the uninjured tree in the second row from the left. (Original.)

It is probable that the presence of alkali in the soil and water, aided in breaking down the Paris green, thus liberating soluble arsenic which damaged the trees.

This case is cited, not for the purpose of alarming those who find it necessary to use an arsenic compound in the form of a spray or otherwise, but simply to show that care should be exercised in its application. In spraying for codling moth there are times when much of the liquid containing arsenate of lead, Paris green or zinc arsenite in suspension, is allowed to run down the trunks of trees and collect at the crowns, resulting in the formation of a collar of arsenic at the ground line. Removal of the soil about the crowns after such heavy spraying would probably eliminate all trouble.

We must apply arsenical sprays for codling moth and other insects, but proper discretion should be used in its application, and especially should care be exercised to prevent the collection of quantities of the liquid at the crown. It is often necessary to spray very heavily and in such cases it is almost impossible to keep the liquid from running down the trunks, and the only remedy is its removal with the soil from about the tree.

THE FROST PROBLEM.

By A. J. Cook, State Commissioner of Horticulture.

Most of us pay extravagantly for fire and life insurance for the security it gives and more for the comfort which attends this feeling of security.

The plum curculio is a serious insect pest. I heard Judge Ransdall, a very successful plum grower of Michigan, say once that he thanked the Lord for this insect. His philosophy was as follows: It is easy to control this enemy, but most persons will not do so. This insures my getting a fine crop of superior fruit, and I am always sure of a great price and a ready market. He could quote Shakespeare with joy: "Sweet are the uses of adversity."

Some of the citrus growers of the South may regard the frost calamity of last January in the same happy frame of mind. One firm expended some $28,000 in the first, and has already spent nearly three times as much to improve its equipment since the freeze, yet the readiness of the firm for the fray saved its fruit and trees, and it is ahead many thousands of dollars.

Three localities in the southland were prepared for frost last year to a greater or lesser degree: Pomona, Corona and the great Limoneira lemon grove. In these localities the saving was immense. Does not this all tend to prove that the citrus growers of the State face an opportunity that may return a rich harvest of profit?

We see by the press that Pomona is pleased with her last year's expenditure. She has paid out one half of a million dollars to increase her equipment for frost protection. She will have 10,000 acres of citrus groves with improved oil pots for heating. The example of Colorado is being followed, as the chambers of commerce and business associations are organizing to give aid in case the "Storm King" comes and help is needed. The motorcycle brigade, organized last year, will be continued and strengthened, and the superior telephone equipment of the Pomona Valley will be at the service of the citrus growers.

News comes from Redlands that the growers there are also alive to the necessity of quick and energetic action, and they are putting thousands upon thousands of dollars in this effort to protect against the possible freeze of the future.

The North is fortunate in her early market, but that will not save her trees. San Diego had never had a damaging freeze before last winter, and no part of the South suffered more in January, 1913, than did many orchards in this supposed frostless area. Does it not behoove the North to prepare to meet the "Frost King," in case he should come? I believe no wise man will build too assuredly on the assurance that his orchard is in the frostless belt.

Mr. C. C. Teague has had very extensive experience in this fight with frost, and has won out in great shape. He will give wise suggestions from his experience at the State Fruit Growers' Convention which convenes at San Jose, December 2d to 4th, inclusive. Fruit growers from the north, central and southern sections should all listen to his words, deciduous growers no less than citrus orchardists, producers of nuts as well as of fruit should show that they are alive to their own best interests by heeding the suggestions and acting on the advice Mr. Teague will give.

Among the scores of letters that come to this office are very many asking for literature on various phases of fruit culture. Upon taking office we found a noticeable dearth of such publications. It is the intention of this Commission to issue authoritative, up-to-date treatises on each of our California fruits, nuts, etc. Already we have able booklets on insects, the date, the fig, the avocado, walnuts, prunes, almonds, apples and olives. The two last mentioned are not up-to-date. Among the inquiries, those on alfalfa and citrus fruits have been very prominent. This has led to our writing on these two subjects. The peach is also in preparation by one of our most successful growers. It is the aim to follow these with monographs on the pear, the cherry, the apricot and up-to-date treatises on the olive and the apple.

GENERAL NOTES.

RECENT IMPORTATIONS OF BENEFICIAL INSECTS IN CALIFORNIA.

During the last two or three months the State Insectary has received a number of species of foreign beneficial insects which are to be introduced into this State.

In the latter part of August, through the kindness of Mr. H. A. Ballou of the Imperial Department of Agriculture for the West Indies, the State Insectary received a consignment of parasitized black scale material from which we reared several hundreds of specimens of a predaceous egg parasite of the black scale, known as *Lecaniobius cockerelli*. These were all liberated in an infested section and the result of this liberation will be watched by many with great interest.

In September a shipment of mealy bug parasites was received through the courtesy of Professor S. I. Kuwana, Entomologist for the Imperial Agricultural Experiment Station of Japan, in conjunction with Mr. Harry S. Smith, superintendent of the State Insectary, who was at that time in Japan. From this shipment we have reared what we believe to be several valuable species of hymenopterous parasites, and we are now attempting to breed them up in sufficient numbers to be released in the sections infested with the mealy bug.

Again in October two more shipments of mealy bug parasites were received from Japan from the same source. The same species of parasites were again reared and strengthens materially our breeding cage supply.

One shipment has been sent by Mr. Smith from the Philippines containing a small internal parasite of the red scale. This arrived in fine condition. Two shipments of black scale parasites were also sent by Mr. Smith from which we have obtained a predaceous Pteromalid on the eggs of the black scale.

With a shipment of parasitized black scales from Peru, sent through the kindness of Mr. C. H. Townsend, in charge of the entomological stations of that country, from which we have obtained several species of a large encyrtid attacking the old scales; with a further supply of parasitized mealy bugs and black scale material, besides several species of ladybirds preying on both the mealy bug and black scale which Mr. Simth is bringing with him from the Orient, we have hopes of doing things along the line of insect natural control the next season. —E. J. VOSLER.

A GREAT TRIUMPH.

The recent decision by the United States Supreme Court, confirming the opinion of the Interstate Commerce Commission, is a signal victory for the Arizona and California lemon growers. It also illustrates the importance of a persistent fight, even though it is the rancher versus the "interests."

When the tariff was raised to 1½¢ per pound the railroad, ever governed by the principle of "charging all that the traffic will bear," raised the freight tariff from $1.00 to $1.15 per hundred pounds. The lemon growers of California, under the leadership of G. Harold Powell of the Citrus Protective League of California and the late Judge A. F. Call, appealed to the Interstate Commerce Commission and secured several hearings. As a result of these hearings they obtained on June 11, 1910, a decision from this body that the amended rate was "unjust and unreasonable." In September, 1910, the railroads filed a complaint with the United States Circuit Court for the District of Kansas, alleging that the Interstate Commerce Commission in this decision had exceeded its powers, as it favored the growers of California as against the interests of the growers of Sicily, and deprived the railroads of a reasonable and just compensation, and was confiscatory. This court in February, 1911, granted a preliminary injunction. The case was then referred to the Commerce Court for a hearing. In October, 1911, this court filed an opinion, overruling the decision of the Interstate Commerce Commission. The ground for reversal was that the decision of the Interstate Commerce Commission was unfair to the foreign producer of lemons. It permitted, however, a rehearing of the case. In November, 1911, the Interstate Commerce Commission reopened the case, and as a result again ordered the railroads to fix a rate not greater than $1.00. Again the railroads asked for a preliminary injunction which was refused, and the $1.00 rate took effect February 15, 1912. The case was again argued before the Commerce Commission in Los Angeles, and the request for an injunction was denied. The railroads then appealed the case to the United States Supreme Court, and this body confirmed the decision of the Interstate Commerce Commission, holding that a rate greater than $1.00 was unreasonable."

G. Harold Powell states that this decision will save to the lemon growers in an average season $200,000 and will materially aid them in the severe competition with Sicily in furnishing our markets with this necessary fruit.

What is more, this advantage is retroactive, extending back to 1909.

There is much that is encouraging in this decision. Ranchers are coming into their own. Even the railroads cannot always rule with a high hand. There is hope that even with the tariff reduced the lemon interests may not wane, but increase until we can supply our home demand from our own groves.—A. J. Cook.

CALENDAR OF INSECT PESTS AND PLANT DISEASES.

By E. J. Vosler, Assistant Superintendent of the State Insectary.

[Under the above heading the author aims to give brief, popular descriptions and methods of controlling insect pests and plant diseases as near as possible just prior to or at the time when the suggestions given should be carried into effect by the growers.]

INSECTS INJURIOUS TO FRUIT TREES.

The Red-humped Caterpillar.

The red-humped caterpillar, *Schizura concinna* S. & A., spends the winter as a pupa in cocoons which are located several inches under the surface of the ground, or among the thickly fallen leaves and other matter under the trees. Hoeing or cultivating close to the trees in the winter time will kill many pupæ of this insect as well as the hibernating stages of other destructive pests. The description of this insect's appearance and work was given in a previous issue.

Scale Insects on Deciduous Trees.

If the fruit trees are infested with scale insects don't let another year lapse before remedial measures are undertaken. The man who grows the best fruit is the man who makes it his business to see that the trees are free from all pests. If the San Jose scale, black scale, brown apricot scale, Italian pear scale and others which might be mentioned are destroying the vitality of your trees, a little time and money spent in spraying will do wonders. What to use for a spray material is another question. Crude oil emulsion, 10 per cent (home-made); crude oil emulsion (prepared), 8 per cent; distillate emulsion, 5 per cent; Yel-ros, 1 to 40, and lime-sulphur, 4.5 degrees Baumé, are all good eradicators. If you are in doubt as to what pest is troubling your trees, send a sample to the office of the State Commissioner of Horticulture, and it will be identified.

Apple Tree Tent Caterpillars.

The two apple tree tent caterpillars, commonly known as the eastern apple tree tent caterpillar and the forest tent caterpillar, both occur in California. The former has a very limited distribution in this State, and the latter is confined to the central and northern portions. Both attack the foliage and the young fruit of the apple. The general appearance of the larvæ of the two species is practically the same. They are hairy caterpillars, about 1$\frac{3}{4}$ inches long when full grown; black in color with distinct yellow and white stripes along the back and with blue and white spots along the sides. The larvæ of the former species spin a web or tent on which they congregate when not feeding; while the latter congregate in masses on the trunks and limbs of the trees. (Fig. 405.) The winter is spent in the egg stage, the egg masses being attached in cylindrical formation to the smaller twigs. Destroying these egg masses during the winter time is one method of controlling these two pests.

The California Tussock Moth.

The California tussock moth (*Hemerocampa vetusta* Boisd.), is distributed throughout the central portion of this State, being especially abundant along the coast. It feeds on the foliage and young fruit of the apple, as well as upon live oak, lupin, cherry and walnut, although the first is the favorite. If this pest, whose larva is a grey caterpillar with numerous colored spots and four prominent white tufts on the upper side, besides two black tufts on the head and one near the posterior end, has been abundant during the past season, it may be advantageous during the winter months to hand-pick the egg masses which are deposited on the limbs and trunks of the trees in the fall. They may be destroyed by burning or immersing in oil.

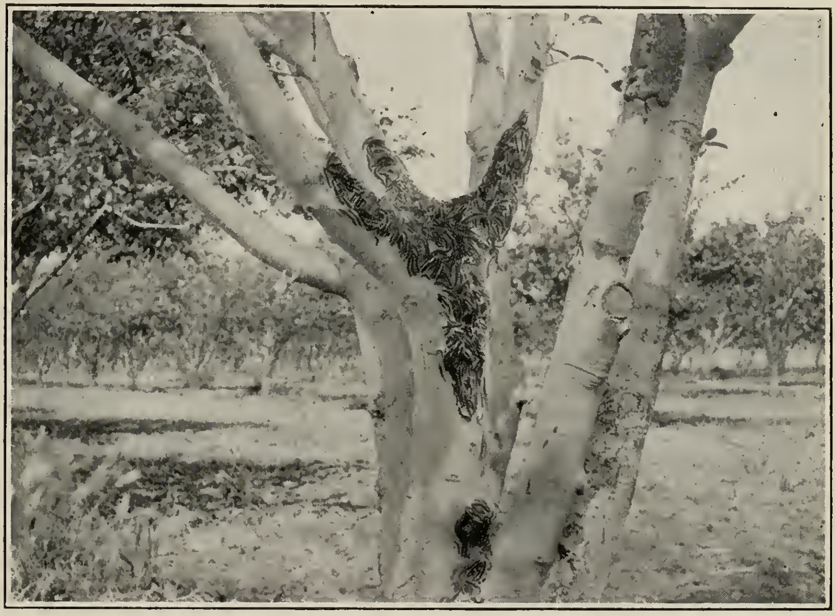

FIG. 405.—Larvæ of the forest tent caterpillar (*Malacosoma disstria* Hubn.), on apple tree. (Cal. Hort. Com.)

STORED PRODUCTS AND TRUCK CROP INSECTS.

Insects Injurious to Stored Products.

In a previous issue of the Monthly Bulletin attention was called to the work of insects in stored products. The grain weevils, bean and pea weevils, and the well known flour moths cause annually an immense amount of damage. If the holders of infested products will take such time and money as is necessary to destroy these pests they will not be the losers. Carbon bisulphide, using five pounds to the thousand cubic feet of space, seems to be the best fumigant. A tight room is necessary and care must be taken that the liquid shall be kept away from any flame as it is highly explosive. The liquid is poured into shallow dishes and soon evaporates into a heavy gas. The best results are obtained when the temperature is above 70 degrees Fahr.

The Hop Flea Beetle.

The hop flea beetle is a small black beetle with a metallic tinge and appears in the spring attacking the hop plants as soon as they appear above ground. Its work is characterized by the skeletonized leaves. On page 231 of "Injurious and Beneficial Insects of California," E. O. Essig recommends the thorough cleaning of the hop fields and burning the rubbish to destroy the hibernating beetles.

DISEASES OF PLANTS.

Pear Blight.

The work of cutting out portions of the trees infested with pear blight (*Bacillus amylovorus*) should be continued until all signs of the dread disease have been eliminated from the orchard. As has been stated before, the blight causes the leaves, blossoms and young fruit to wither and turn black on the affected portions which do not fall, remaining attached to the twigs during the winter. The disease proceeds downward into the larger branches which are often killed very rapidly. Care must be taken to disinfect the pruning tools with a solution of corrosive sublimate (bichloride of mercury) 1 to 1,000, and to cut below any sign of the affected area at the time when the diseased parts are removed and subsequently burned.

Stem Rot of Alfalfa.

According to the California Agricultural Experiment Station, a stem rot fungus causes considerable damage to alfalfa at times in this State, as well as in other states. The fungus appears to be a cosmopolitan species affecting various plants all over the world. They[1] describe the characteristic work of this fungus as follows: The stems wilt and die after nearly reaching maturity. The infestation appears to be scattered the attacked stems here and there in the fields are easily contrasted with the healthy green appearance of other stalks. The disease is particularly abundant during the spring when the ground is moist and where the stand of alfalfa is so thick as to shade the ground. The examination of an affected stem shows a decayed base covered more or less with a white mold. No remedy can be suggested other than the plowing up of badly infested fields, which should be planted to other crops for several years.

Shot-Hole Fungus of Almond Trees.

This fungus, as suggested by its name, gives a shot-hole effect to the almond leaves. The young twigs are also sometimes spotted. A strong attack of this disease defoliates the trees early in the season, the crop being badly injured as a result. Control measures consist in spraying with Bordeaux mixture, 5-5-50 formula in the spring as the buds are opening.

Shot-Hole and Fruit Spot of Apricot.

This disease is also known as the peach blight fungus and causes the spotting of the fruit of the apricot, as well as a shot-hole effect on the leaves and killing of the buds. If the apricot orchardist whose trees have been affected by this fungus has neglected to spray with Bordeaux mixture during November, there is all the more reason to apply a thorough spraying in the spring just as soon as the buds open.

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[1] Ralph E. Smith and Elizabeth H. Smith. California Plant Diseases. California Agri. Exp. Sta. Bull. No. 218.

Leaf-Curl of Peach.

We wish to again call the attention of the peach growers to the leaf-curl fungus. This disease causes the curling of the peach leaves as they develop in the spring and which often wither and fall together with part of the young fruit. Later on a new growth of leaves develop, but the harm has been done. Spray with Bordeaux mixture 5-5-50, just prior to the opening of the buds in the spring.

Apple Scab.

Apple scab is easily recognized by the scabby patches developed on the surface of the fruit in which the brown velvet growth of the fungus appears. Spray with Bordeaux mixture 5-5-50, just as the buds are opening, again after the petals fall, and once or twice at intervals later where the variety or location is particularly advantageous to the growth of the fungus. Arsenate of lead, a remedy for the codling moth, can be combined with the Bordeaux mixture, thus eliminating two sprayings for scab and codling moth at the time both should be applied.

INSECT NOTES.

Conducted by the Editor.

The potato tuber moth, *Phthorimæa operculella* Zel. The occurrence of the potato tuber moth in the northern part of the State was made known by its discovery recently in Shasta County. About 150 sacks of potatoes recently dug and placed in a barn were found to contain a bad infestation of the pest.—Geo. P. Weldon.

The large green predaceous ground beetle, *Calosoma scrutator* Fab., has been received in quite large quantities from Horticultural Commissioner B. V. Sharp of Hanford, California. These were collected by wood choppers, who stated they were feeding upon caterpillars destructive to willows.

Narcissus bulbs have been received from Horticultural Commissioner Stabler of Sutter County, containing the larvæ of the large Narcissus bulb fly, *Merodon equestris* Fab. The bulbs in many instances were badly hollowed out by the feeding larvæ.—Leroy Childs.

Quite a number of specimens of potatoes injured by wireworms have been repeatedly sent to this office with the inquiry as to whether the work was done by the potato tuber moth or not. The burrows of the potato tuber moth are very conspicuous just underneath the skin or throughout the interior of the potato, while the small holes of the wireworm usually penetrate only a short distance.

The woolly aphis, *Schizoneura lanigera* Hans. An effort is being made to determine the distribution in the State of the woolly aphis on pear roots. At present it has been observed in the following counties: Sacramento, Yolo, Contra Costa, Sonoma, Santa Clara, Lake, Nevada, Placer, and Napa. It is probable that it will be found, upon investigation, in practically every pear-growing section of the State. It is quite a serious pest because of its habit of feeding on the fibrous roots.—Geo. P. Weldon.

Platynus maculicollis, a small brown beetle belonging to the family Carabidæ, has been reported as occurring in annoying numbers under houses and in cellars at Sacramento. These insects are harmless and often beneficial in that they feed predaceously upon smaller insects and mites.—Leroy Childs.

A single adult specimen of the cherry borer, *Dicerca divaricata* Say, has been received from Nevada City, Nevada County, Cal., where it is claimed that the young tips of cherry trees have been injured by it.

The cypress twig-borer, *Phloeosinus cristatus* Lec., has just been received from San Luis Obispo.

The citrus white fly, *Aleyrodes citri*. A recent inspection of trees in Marysville, made by E. J. Branigan, indicated that the citrus white fly is still present in that section, but only in very limited numbers.—Geo. P. Weldon.

The potato flea beetle, *Epitrix cucumeris* Harris, has been received from Placerville November 11, 1913, where it has been working upon the foliage of potatoes.

The peach twig-borer, *Anarsia lineatella*. This pest of the peach is found very abundantly hibernating in crotches of peach, apricot, and plum trees, of both orchards and nurseries.—Geo. P. Weldon.

The San Jose scale, *Aspidiotus perniciosus* Comst., has been taken in Imperial County on pears by Horticultural Commissioner F. W. Waite. The entire surface of the fruit sent in was completely covered with the scale and shows the adaptability of this insect in a hot climate.

Quite a serious infestation of nematode on roots of peach, was found in Kings County.—Geo. P. Weldon.

Specimens of the larvæ of *Prionus* sp. have been received from Chico, California, with the report that they were causing great injury to the roots of prune trees.—E. J. Vosler.

NOTES FROM THE COUNTY COMMISSIONERS.

By Geo. P. Weldon, Chief Deputy State Commissioner of Horticulture.

This office is in receipt of the annual report of County Horticultural Commissioner R. S. Vaile for Ventura County in the form of a printed bulletin. This report is neatly gotten up and contains much information of interest and value to the fruit growers of the county, and reflects much credit upon its able author.

Mr. George A. Lamiman, in his November report to the Board of Supervisors of Shasta County, tells of an important experiment he is conducting for the good of the fruit growers. Recognizing the need of a cover crop that will make a good winter growth, and believing that winter vetch is such a crop if it can be grown successfully, he has inoculated the seed with the proper bacteria in hopes that a thrifty growth will be the result.

County Horticultural Commissioner O. C. McManus, of Modoc County, has just finished a campaign against pear blight. He states that he has been able to secure the co-operation of the growers in his county in this work. When first beginning his term of office Mr. McManus found there was not a single spray pump of any kind in the county. Through his efforts, at the present time, there are about twenty in use. This speaks well for the work that has been instituted for the benefit of the growers of Modoc County.

RED SPIDER SPREAD BY WINDS.

By H. P. Stabler, Yuba City, Horticultural Commissioner, Sutter County.

During the summer of 1912 Mr. C. K. Woods, a fruit grower and nurseryman of Sutter County, became convinced from his own observations that red spiders are carried greater distances by winds than is generally supposed. For years it has been known that red spiders can be blown from one tree to another in an orchard, and in many instances for the distance of several rows, but it was generally believed that a county road, a city lot or similar barrier was sufficient to prevent the spread of the pest by the agency of the winds.

Acting on this theory growers felt that by treating their own orchards they were not likely to have an infestation from neglected trees in the neighborhood. Mr. Woods held otherwise and was quite satisfied in his own mind that proper tests would establish the correctness of his contention. Unfortunately for the purpose of making tests the unusually heavy rains occurring about September 1, 1912, disposed of the red spider infestation for the season.

Red spider infestation was unusually severe the past summer and it was determined to test the efficiency of the winds as a carrier of the mite. With this object in view, Mr. E. E. Munger of Yuba City placed a sheet of sticky fly paper on a board and nailed it to a fence twenty feet from an infested tree. This was done on August 2d and after twenty-four hours examination disclosed the presence of a great many

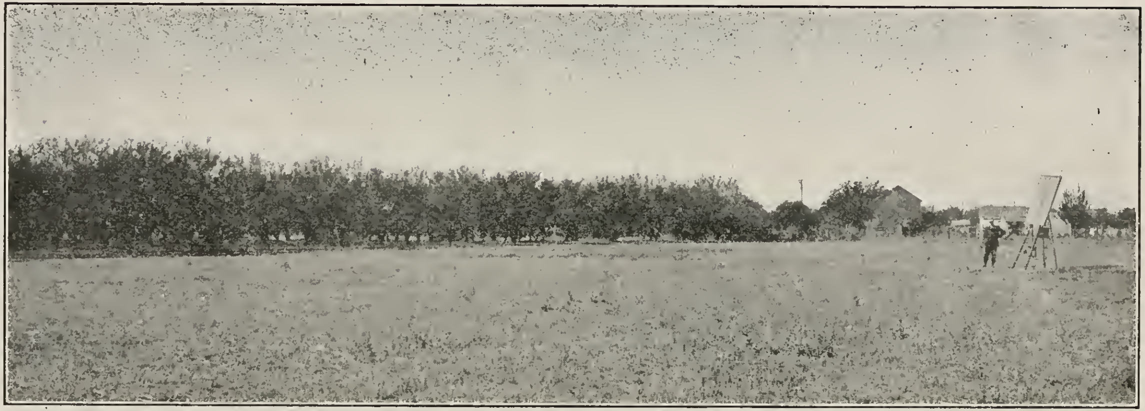

FIG. 406.—General view of orchard and apparatus used in trapping the mite. (Photo by Geo. P. Weldon.)

mites. On August 5th a sheet of sticky fly paper on a board was nailed to a telephone pole twelve feet from the ground, one hundred feet north of a badly infested ten-acre almond orchard of very large trees. The spiders found on the sheet the next day were very numerous. On August 10th the sticky paper was placed 250 feet from the orchard and 30 feet from the ground on top of a tank house. Spiders were found on the paper the next day. The next test was made 650 feet from the infested orchard and the paper placed fifty feet from the ground on top of a school house, with the result that many spiders were found on the paper the next day.

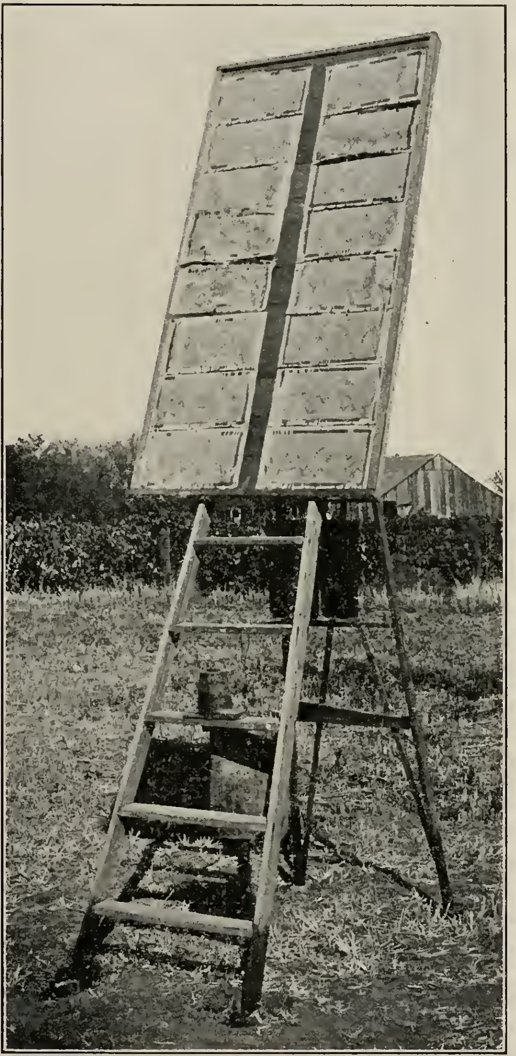

FIG. 407.—Close view of the apparatus showing the legs standing in cans of water and oil. (Photo by Geo. P. Weldon.)

At this stage of the experiments Mr. Geo. P. Weldon, Deputy State Commissioner of Horticulture, visited this locality and saw the results of the experiments. He identified the spiders on the sticky paper. At his suggestion the next tests were made even more carefully; the fly paper was tacked to a large fruit-drying tray, which was nailed to a step-ladder, the legs of which were placed in cans of water over which oil was floated. This was done to prove beyond doubt that the spiders were blown on the paper and did not crawl there.

On August 21st four sheets of the sticky paper were placed on the tray, which was nailed to the insulated step ladder, sixty feet from badly infested trees in another orchard, and in twenty-four hours about fifteen spiders were counted on each sheet of paper. The final test was made on the 27th of August with the same apparatus placed 105 feet from the infested orchard. Fourteen sheets of paper were used and after 24 hours many mites were found on the paper.

Mr. Weldon was here again at this time, and examined the appliances and took the photographs which accompany this article. We believe we have established the fact that red spiders are blown sufficient distances by the wind to make an infested orchard a menace to orchards within a reasonable distance. All of these tests were made at times when the usual light summer south winds were blowing. The days were usually calm and the winds blew at night.

QUARANTINE DIVISION.

REPORT FOR THE MONTH OF OCTOBER, 1913.

By Frederick Maskew, Chief Deputy Quarantine Officer, San Francisco, California.

SAN FRANCISCO STATION.

Horticultural imports—

		Parcels.
Ships inspected	45	
Passed as free from pests		103,458
Fumigated		3,231
Destroyed or returned		96
Contraband destroyed		5
Total parcels horticultural products for the month		106,790

Horticultural exports—

	Parcels.
Inspected and certified	2,202

Pests Intercepted.

From Honolulu—

Hemichionaspis sp. and *Chrysomphalus* sp. on green cocoanuts and stems.

Coccus acuminatus and *Aleyrodes* sp. on cut flowers.

Lecanium sp. on betel leaves.

Diaspis bromeliæ and *Pseudococcus* sp. on pineapples.

From China—

Chionaspis citri, Pseudaonidia trilobitiformis, Lepidosaphes beckii, Chrysomphalus aurantii, Parlatoria ziziphus and *Phomopsis citri* on pomelos.

Parlatoria pergandii, Lecanium sp., *Pulvinaria* sp., *Chionaspis citri, Aleyrodes citri* and *Cladosporium citri* on citrus plants.

Cylas formicarius in sweet potatoes.

Weevil sp. in kaffir corn and chestnuts.

From Tahiti—

Morganella maskelli on oranges.

From New Jersey—

Aspidiotus boisduvalii on orchids.

From Belgium—

Aleyrodes sp. and moth larvæ on azaleas.

Psylla sp., *Aspidiotus britannicus, Coccus hesperidum* and *Pseudococcus* sp. on bay trees.

LOS ANGELES STATION.

Horticultural imports—

		Parcels.
Ships inspected	19	
Passed as free from pests		31,325
Fumigated		876
Destroyed		1
Returned		0
Contraband		0
Total parcels horticultural products for the month		32,202

Pests Intercepted.

From Belgium—

Aspidiotus britannicus, Coccus hesperidum and *Pseudococcus longispinus* on bays.

Aspidiotus hederæ on aucuba and kentia palms.

Coccus hesperidum on camellias and euonymus.

Chrysomphalus dictyospermi and *Diaspis boisduvalii* on orchids.

Hemichionaspis aspidistræ on *Aspidistra lurida.*

Pseudococcus citri on mimosa and lapageria.

Pseudococcus longispinus on *Ficus* sp.

From Florida—
Aleyrodes sps. on cocoa palm.
Lepidosaphes beckii and *Phomopsis citri* on pomelos.
Pseudococcus longispinus on ferns.
Parlatoria pergandii on pandanus.

From Indiana—
Hemichionaspis aspidistræ on *Aspidistra lurida.*

From Mexico—
Aspidiotus cyanophylli, Cerataphis lataniæ, Chrysomphalus aonidum, Ischnaspis longirostris, Pseudococcus sp., and *Saissetia hemisphærica* on palms.
Chrysomphalus dictyospermi on pandanus.

From New York—
Lepidosaphes beckii on pomelos.

From Pennsylvania—
Aphididæ sp., *Aspidiotus camelliæ, Chrysomphalus aonidum, Coccus longulus* and *Diaspis* sp. on maranta.
Chrysomphalus aurantii and *Parlatoria pergandii* on pandanus.
Coccus hesperidum on aralia.
Pseudococcus citri on crotons.
Pseudococcus longispinus on elkhorn.

SAN DIEGO STATION.

Horticultural imports—

		Parcels.
Ships inspected	24	
Passed as free from pests		1,569
Fumigated		6
Destroyed		4
Returned		1
Contraband		2
Total parcels horticultural products for the month		1,582

Pests Intercepted.

From Mexico—
Chrysomphalus aurantii on citrons.
Lepidosaphes gloverii on sour limes.
Unidentified Lepidopterous and Coleopterous larvæ and pupæ on mango seed.

From Arizona—
Bruchus sp. in "screw beans."

From Pennsylvania—
Aspidiotus camelliæ on palms.

SANTA BARBARA STATION.

No report.

EUREKA STATION.

Ships inspected 6
No horticultural imports.

QUARANTINE NOTE.

By George Compere.

The sending by the Federal Horticultural Board of Frederick Maskew, Chief Deputy Quarantine Officer, to the Hawaiian Islands to study the Mediterranean fruit fly situation will very likely prove to be the most important step which has yet been taken to prevent the accidental introduction of that pest to the main land.

ERRATA.

*Nos. 1 and 2.

(Injurious and Beneficial Insects of California.)

Pages 3, 10, 306 (and elsewhere), **Dehydrated lime** should read **hydrated lime.**

Page 21, Photograph of katydid should be labeled **Scudderia** and not **Microcentrum laurifolium.**

Page 105, **Hyperaspis mœrens** for **Scymnus mœrens.**

Page 110, **Pulvinaria amygdalus** for **Pulvianaria amygdalus.**

Page 182, **The forest tent caterpillar** for **the Western apple-tree tent caterpillar.**

Page 189, The photograph is of the **California oak moth (Phryganidia californica Pack.)** and not of **the spotless webworm.**

Page 199, line 22, should read **Nearly all the members** and not **all the members.**

Page 209, **Olla oculata** synonymous with **Olla abdominalis.**

Page 210, **Olla plagiata** synonymous with **Olla abdominalis.**

Page 220, line 15, **An imported species** and not **a native species.**

Page 229, **Diabrotica trivittata** is the common California species and not **Diabrotica vittata.**

Pages 270 and 272, **Pteromalidæ** for **Encyrtidæ.**

Page 300, Formula for **lime-sulphur (Home made)** recommended by P. J. O'Gara is as follows:

Lime	**50 pounds**
Sulphur (flower of)	**110 pounds**
Water to make	**50 gallons**

Page 302, **Whale-oil soap 1 pound** and not **40 pounds** as given in formula.

Page 304, line 11, **Add distillate and the caustic soda** for **add the caustic soda.**

Page 304, line 21, **Distillate 20 gallons** and not **20 pounds.**

Page 333, line 18, **Orchards previously sprayed** for **orchards subsequently sprayed.**

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*Detach this page and paste it in the back of "Injurious and Beneficial Insects of California."

ERRATA.

No. 5.

Page 536, Under illustration, **Cylas** for **Cyclas.**

No. 8.

On cover, the illustration is the same as Fig. 341. The explanations are for Fig. 340 which should have been here.

Page 624, **Hyalopterus arundinis** for **Aphis pruinfoilæ.**

Page 630, **Murgantia histrionica** for **Murgantiaa histronica.**

No. 10.

Page 685, **Eucaluptus globulus** for **Eucaluptus globulous.**

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